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LOCAM 5

PROGRAMMER/USER'S MANUAL

Volume II

RCA/Government and Commercial Systems
Automated Systems Divison
Burlington, Massachussetts

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Prepared for:

Systems Analysis Division
Plans and Analysis Directorate
US Army Missile Research and Development Command
Redstone Arsenal, Alabama 35809

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Logistics Cost Analysis Model 5 is an upgraded model of maintenance policies utilized by the US Army Missile Command and the US Army Weapons Command. Model progression included Missile Command, Weapons Command cost analysis of maintenance policies, and Logistics Cost Analysis Models 2, 3, and 4. It is an analytical computer program capable of representing field logistic support functions and flow. It computes life cycle costs and operational

ABSTRACT (Continued on p 1473B)

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availability for alternate system support concepts. Output includes provisioning requirements and operational elements both by numbers and cost. Variable dimensions are limited only by the computer, and are input based on practical considerations. Parameters include extensive specification of factors for ~~the following:~~ deployment, equipment, supply, maintenance, and test equipment. Sensitivity to all input factors is possible.

1473B

February 1977

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Volume II

Ernest C. Seaberg and Russell E. Howe

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Redstone Arsenal, Alabama 35809

FOREWORD

The LOCAM 5 Programmer/User's Manual Volume II was written under Contract DAAH01-76-C-1071. The work was performed with the US Army Missile Research and Development Command under the general technical cognizance of Mr. Raymon S. Dotson, Systems Analysis Division, Plans and Analysis Directorate, Missile Research and Development Command, Redstone Arsenal, Alabama. The program also produced a companion document entitled LOCAM 5 Executive Summary Volume I.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the contributions made to this document and the LOCAM 5 Program by Mr. Joseph H. Nordman, Systems Analysis Division, US Army Missile Research and Development Command, and to Mr. William E. Rapp, Missile and Surface Radar Division, RCA Government and Commercial Systems, Moorestown, New Jersey. LOCAM 5 owes its capability to run efficiently to their superior programming skills. In addition, many of the descriptions and explanations contained in this manual are excerpts from prior documentation by Mr. Rapp.

The authors also wish to acknowledge the contributions of the contracting officer's technical representative, Mr. Raymon S. Dotson, to the design and update of the LOCAM 5 computer program. The LOCAM 5 model was originally developed for US Army Missile Command. Many improvements and revisions made since the original submission were directly under the cognizance of Mr. Dotson. He and Mr. Harry E. Cook, Chief of the Systems Analysis Office at US Army Missile Research and Development Command, are directly responsible for many applications of the model to land combat missile systems and the resulting documentation of these logistic cost analyses conducted at US Army Missile Research and Development Command.

SECTION 1
INTRODUCTION

The Logistic Cost Analysis Model (LOCAM) 5 provides a unique tool for the evaluation of alternate support postures for Army equipment. Tradeoffs are made on the basis of cost and availability. As with other tools of this type, the validity and usefulness of the analyses performed are to a great degree dependent on the skill of the analyst in its application.

The LOCAM 5 program is specifically structured to perform logistic analyses in maintenance support situations where the emphasis is on the support channels required for a diversity of operating equipments.

In using the program, the analyst structures his input data as a sequence of installed equipments which require support. The program processes each equipment sequentially. Provision is made within the program to store cumulative demand for work at common test and repair facilities over several different equipments. The input process groups the equipments which share such common facilities and when the last equipment in the group is reached, the costs for the support channels are computed based on the total work load in the accumulators. The accumulators are then reset and the next group of equipments may be processed.

Four types of support channels may be modeled, simultaneously and asynchronously, with respect to the input sequence of equipments. In the terminology of the program, these are as follows:

a) Automatic Test Equipment Support (Field or Depot).

b) Special Depot Test Equipment.

c) Calibration sets in the field.

d) Contact support teams and test sets.

Section 8.1 further explains these support channels and the variety of costs included in the computations.

Section 7 describes the unique sensitivity testing feature of the model whereby inputs can be varied through a range of values during any set of computer runs.

Other sections of this manual are devoted to detailed descriptions of portions of the model. These include inputs and outputs and program structure. Specific aspects covered include the program flow, the principal mathematical formulations, the program listing, and those aspects related to the preparation of the input data base.

Symbols and input definitions are contained in Appendices A and B. An application of the model is discussed in Appendix C to acquaint potential users with the operation of LOCAM 5. An explanation of the theory and rationale associated with the application procedure is also included. Appendix C addresses the prediction of logistics support costs for a land combat missile system. Although derived from a hypothetical data base, the deployment is representative of actual US Army missile deployments overseas and continental United States scenarios. The example includes the use of special features describing realistic Army maintenance rules. Thus potential users, after compilation of the LOCAM 5 program on their computer, can follow the procedure outlined in this manual as the initial step in becoming proficient in the use and operation of the program.

SECTION 2
LOCAM 5 DESCRIPTION AND VERSATILITY

LOCAM 5 is a computerized mathematical model for evaluating life cycle costs (LCC) and for recommending optimum repair levels, repair versus discard-at-failure, test equipment requirements, and spare provisioning, etc.

Applications of LOCAM 5 involve a systems engineering approach to the evaluation of alternative logistics postures such that the repair of modules/subassemblies or LRUs is facilitated to reduce LCC. The steps involved in the systems engineering procedure are as follows:

a) To establish requirements (identify, validate, and schedule data requirements for timely delivery).

b) To establish data base.

c) To define alternative logistics postures.

d) To conduct trade-off evaluation of alternatives through logistics modeling techniques (include sensitivity analysis).

e) To evaluate results of tradeoff studies.

f) To present results including recommendations for most cost effective approach to logistics support.

2.1 LOCAM 5 Description

LOCAM 5 is a logistic model developed for the purpose of evaluating alternate maintenance postures on basis of LCC. Although organizational and maintenance (O&M) phase and costs are emphasized, LOCAM 5 also accounts for equipment nonrecurring development costs, the investment in test equipment, facilities, spares, end item equipments, replacement subassemblies and parts, as well as the on-going costs of manpower, attrition, transportation and handling, and administration of the support system.

The model, or some version of it has found use, not only within the US Army, but is included in the model repetoire of the US Navy (NADC) and the US Air Force (AFLC).

LOCAM 5 is driven by those aspects of the equipment characteristics that create flow through the support system such as maintenance incident rate [inverse of mean time between maintenance actions (MTBMA)], the fraction of time the system is "on," scrap rate, the false failure of true failure ratio, and attrition. As indicated in Figure 1, this driving force creates demands on the support system, determined in part by the maintainability characteristics as they affect and are affected by the

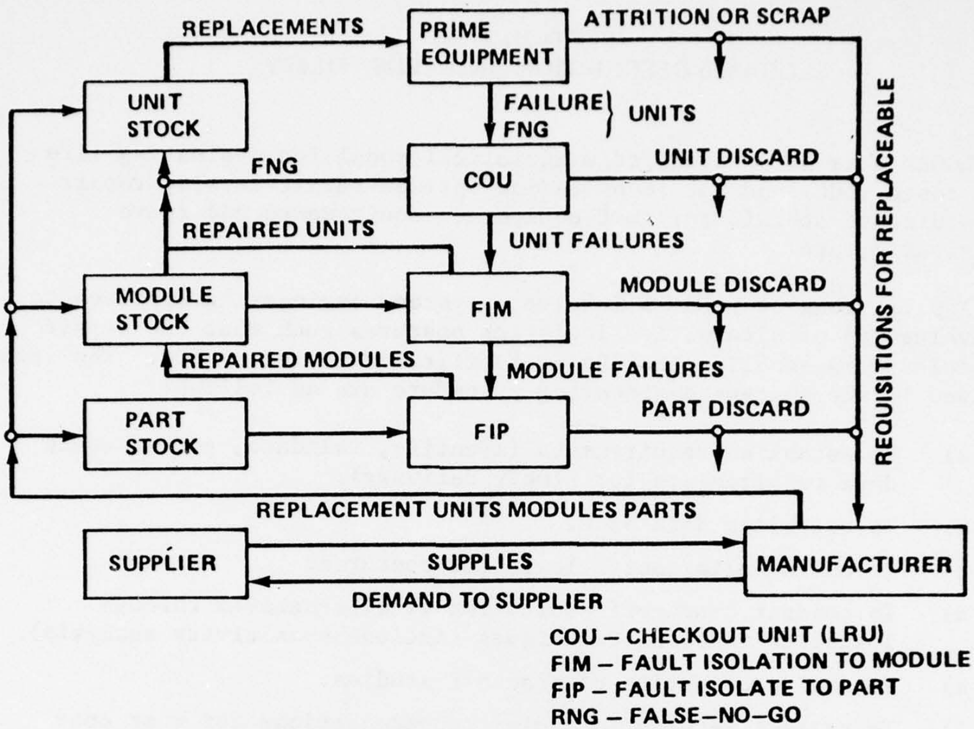


Figure 1. Basic LOCAM 5 repair flow framework.

test equipment, level of training (and hence manpower costs), and time to repair. The spares (quantity and location) which reflect the effect of the length of the pipe, mission duration, level of repair, and the deployment of facilities are also affected.

The end result is a means of rapidly examining the effects of many basic ways of supporting the end item equipment with variation in stock locations as well, as indicated in Figure 2. In Figure 2 an X indicates that some action occurs as described in the comments around the perimeter of the matrix. Thus, test equipment will be located at Equipment, at Direct Support and at Depot for the maintenance policy designated by GH. The test equipment can isolate faults to the level of the failed UNIT/LRU and (at Depot) to the failed MODULE. Additionally, the spare UNITS/LRUs may be located at any of four areas indicated in Figure 2.

Because LOCAM 5 has been developed principally for Army use, Figure 2 uses Army terminology. The support echelons, however, could just as well be representative of an Air Force or Navy hierarchy. In Air Force terms, Direct Support would be Organizational or Base Support, General Support would represent the Air Force Intermediate Level Shops, and Depot would be an Air Material Area. In Naval terminology, Equipment Level would be shipboard which might also contain Organizational Support.

TEST EQUIPMENT WILL BE LOCATED AT

FOR THE MAINTENANCE POLICY DESIGNATED BY

TEST EQUIPMENT CAN ISOLATE FAULTS TO THIS LEVEL

	GA	GB	GD	GE	GF	GG	GH	GL	GM	GN	GO	GP	GQ	GR	GS	GT	
EQUIPMENT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UNIT
DIRECT SUPPORT		X	X		X		X	X	X	X	X	X	X				UNIT
			X					X	X	X							MODULE
								X									PART
GENERAL SUPPORT				X	X				X		X	X		X	X		UNIT
				X	X				X		X	X		X	X		MODULE
									X		X			X			PART
DEPOT						X	X			X		X	X		X	X	UNIT
						X	X			X		X	X		X	X	MODULE
										X		X	X		X	X	PART

UNIT MODULE PART

REPAIR WILL BE ACCOMPLISHED BY DISCARDING AND REPLACING THE FAILED.

Figure 2. Maintenance policy matrix.

TABLE 1. SUPPORT ECHELONS

LOCAM	Army	Air Force	Navy
Equipment (E)	Organization	Equipment	Equipment
Field (F)	Direct	Base Support	Shipboard
Intermediate (I)	General	Intermediate Shop Level	Tender
Depot (D)	Depot	Air Materiel Area	Shipyard

Intermediate Support would be supplied by Tender and Depot would represent Shipyard (Table 1). Other inputs could be judiciously selected such that the LOCAM model could apply as well to logistic or LCC studies of the other services.

The yardsticks created by LOCAM 5 are the LCC (investment plus ongoing costs for the specified life of the equipment) and inherent availability of each LRU.

The overall approach to a typical LCC effort is presented in Figure 3. First the LCC plan is updated to assure compatibility of Army goals and approaches with the program requirements. This effort is accomplished in conjunction with establishment of interfaces with all sources of information pertinent to the LCC analyses. Through interaction with Army organizations, contractor activities and consultants, the LCC activity identifies specific requirements for analyses to be performed, those cost elements most pertinent to individual subsystems/analyses, and the nature of available/required inputs and required outputs forms. As these requirements take shape, the LOCAM cost model is adapted to fit the planned analyses. All cost analyses are subject to an iterative process whereby analysis requirements and cost factors are combined to formulate an analysis which is performed using the LOCAM 5 model. Results of analyses are provided primarily to the system effectiveness analysis, Integrated Logistics Support (ILS) planning, and planning activities. LCC reports consisting of cost estimates, sensitivity analyses, description of cost methodology, and supporting factors/cost estimating relationships are provided.

In the performance of a typical baseline analysis, data are generated which show not only the LCC but the allocation of these costs by phase, equipment, and effort. In addition, sensitivity analyses are used to show the effect on LCC of varying selected equipment design, operation, and support factors. These analyses are formulated to support design activity decisions and to amplify the impact of determined system characteristics. Typical candidates for cost sensitivity analysis include equipment MTBMA, production equipment costs, equipment utilization, equipment life, and deployment length.

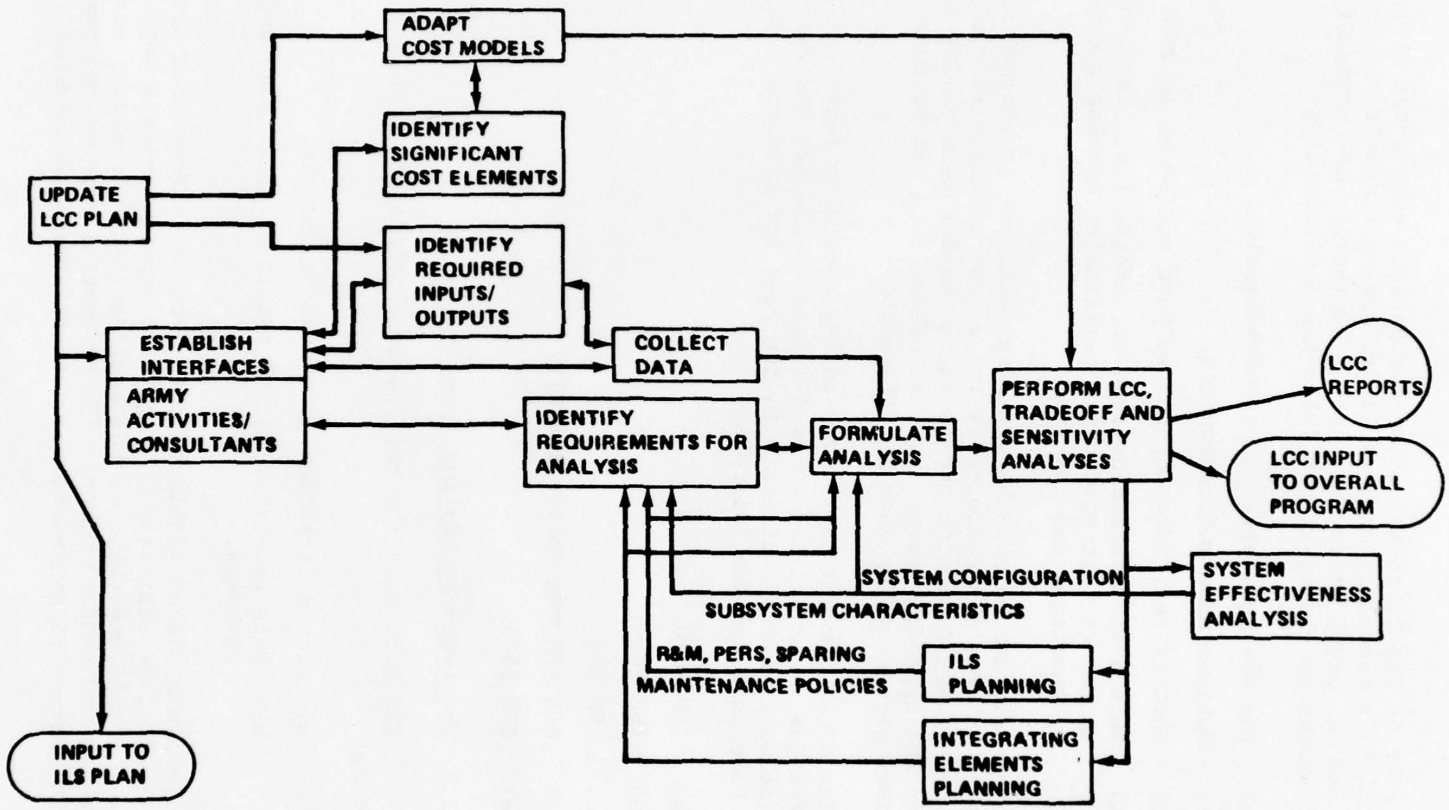


Figure 3. Overall LCC approach.

Prior to the first iteration and between subsequent iterations, the LCC effort is generally engaged in performing tradeoffs of the cost of competing equipment and/or concepts. Minimally this tradeoff activity is envisioned as aiding in the following determinations:

a) The desired degree of standardization.

b) Optimum maintenance manning.

c) Whether individual or shared test equipment is more desirable.

d) Method of maintaining each equipment; i.e., level of repair, amount of test equipment justifiable, sparing and provisioning by quantity, and location.

Tradeoffs can be made by changing equipment or concept model input values to reflect the characteristics of the alternative equipments or concepts. Comparison with the baseline results then yields data to justify one approach versus another. These data can be supplied to the cognizant group seeking such justification.

The LOCAM 5 model can be run on any medium or large scale computer with FORTRAN IV capability and sufficient wordlength and memory. Various computation facilities utilized in the past for previous versions of the model have included the following:

a) IBM 7090.

b) IBM 7094.

c) IBM 360.

d) RCA SPECTRA 7045 (UNIVAC).

e) CDC 6600.

2.2 The LOCAM 5 Modeling Interface

The data base for the LCC model (LOCAM 5) should include the following:

a) The delineation of equipment factors.

b) Data generated as the result of operations and equipment analysis.

The synthesis of viable support systems is dependent upon the results of these activities. Alternate support systems which meet the workload demand and consider the application of inventory standard test equipments and general purpose ATE or special support equipment with varying degrees of automation can be considered as tradeoff factors.

Figure 4 illustrates the overall framework within which the support and test equipment tradeoffs can be conducted. As illustrated, the application of the LOCAM model to the support or test equipment definition requires consideration of the significant factors to be traded off and consideration in specifying meaningful quantitative data as inputs to the mathematical model. These data are generally based on a review of the operational concept, followed by a period of data collection from various sources and data consolidation for use in the analysis.

This involves information from varied sources over and above the support and test equipment interface. From a support and test equipment viewpoint, emphasis is placed on maintenance support factors as they pertain to test equipment characteristics/cost (manual, ATE, hybrid), repair times, checkout times, support equipment maintenance, mobility, etc.

2.3 LOCAM 5 Applications

LOCAM 5 can be applied to nearly any equipment at any stage of its life and yield worthwhile benefits. It enables the user to make enlightened decisions based on the results of its manipulations of many factors. However, the model is particularly useful when it can be applied early in the life of the system. When it is used in the concept phase or early in system design, LOCAM may affect decisions that influence the design of equipment in ways such that optimum support may be realized when the equipment goes into the field.

For example, LOCAM provides data and support analyses leading to better decisions in such areas as the following:

a) What spares should be stocked and where should spare stocks be located?

b) How much reliability and maintainability should be designed into the equipment?

c) Should design be based on repair or throwaway and at what level?

d) How many test and repair men are needed at Direct Support, General Support, and Depot?

Such questions are examined in view of the cost to design, produce, and maintain the equipment.

LOCAM 5 is a flexible and versatile program which has been used to address a variety of questions. In addition to those decision areas mentioned previously, it has been used as follows:

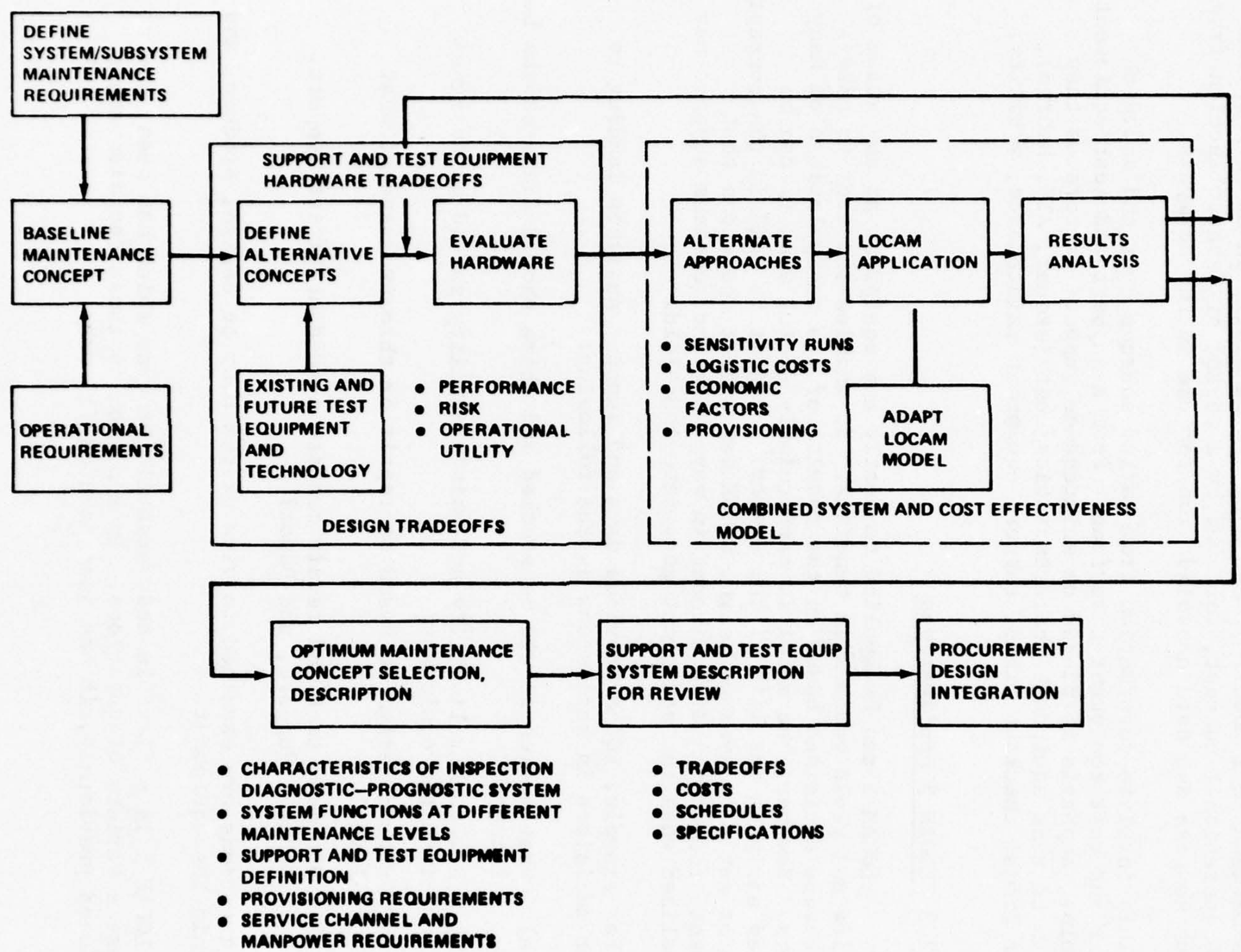


Figure 4. Support and test equipment interface with overall logistics model tradeoffs.

a) To choose from a wide variety of support possibilities. Should the unit be a throwaway or should it be repairable? To what level should it be repairable?

b) To study the effects of pipeline lengths and transportation costs. Is it possible that faster, more expensive transport is better in the long run than slower, cheaper means?

c) To evaluate the administrative and clerical costs of the support and replenishment system.

d) To study manpower costs. Can manpower costs be reduced (by introducing new equipment or techniques) sufficiently that overall costs are also reduced? At what point in time is the investment "paid back" by reduced manpower costs.

The preceding list is not an all inclusive one; however, it does serve to indicate the versatility of the model.

2.4 Logistic Cost Factors

LOCAM 5 considers the costs associated with four phases of the life of an equipment or system: development, production, operation, and end-of-program salvage. Salvage is an event rather than a life cycle time period. There are program inputs through which the user can specify a wide vairety of LCC associated data.

LOCAM generates a total LCC for each of the alternative support policies considered. The summary cost matrix, that is, the cost outputs, is shown in Table 2. The mnemonics in Table 2 are simply the names given to the cost factors in the program; they are not meaningful here except to indicate the cost element and program phase combinations for which costs are computed. (Section 6 contains cost factors computations, etc.). As such, Table 2 indicates the wide range of cost areas which may be considered in a LOCAM run.

To present the depth in which these factors are considered is not within the scope of the present section. For a brief but typical example, however, the development cost for prime equipment (CED) is treated as a nonrecurring cost and can include fixed cost factors to account for concept and definition phases. The cost of production of prime equipment (CEP) is the sum of a nonrecurring cost term plus a recurring cost term which is dependent on the quantity purchased. The grand cost total (GCT) discounted to appear in present value form (PVGCT) appears at the bottom of the last column.

2.5 Test Equipment and Manpower Modeling

In LOCAM 5, four types of test equipment and associated manpower can be modeled. Two types are used to represent Field or Depot service channels. By suitable selection of program controls (Appendix B),

TABLE 2. LOCAM COST MATRIX

Element of Cost	Acquisition		Time Phase		
	Development	Production	Replenishment Support for N Years	Salvage Value at End of Program	Sub-Total by Element of Cost
Prime Equipment	CED	CEP	*	CEV	CET
Test Equipment	CTSD/ CTSOFT	CTSP	CTSR	CTSV	CTST
Facilities			CFR		CFT
Manpower	--	CMPPY	CMPR/ CMPRR	--	CMPT
Material	--	CIVP	CIVR	CIVV/CSVR	CIVT
Reorder Cost	--	--	CROR	--	CROT
Storage Cost			CWHR		CWHT
Supply Administration	--	CSAP	CSAR	--	CSAT
Shipping and Handling			CSHR	--	CSHT
Cost Totals	CD	CP	CR	CS	GCT
Present Value Totals	PVCD	PVCP	PVCR	PVCS	PVGCT

*Per other entries.

the maintenance manpower at these service channels can either be shared or dedicated. Type I test equipment is generally used to represent Field or Depot ATE. Type II generally represents Depot manual test equipment. Type I can always be Field located. By a suitable setting of a program control, either Type I or II will be Depot located (they cannot be concurrently modeled at Depot). The other two types of test equipment were originally included to represent:

a) Contact support sets and teams.

b) Calibration equipment sets and teams.

It is emphasized, however, that all types of test equipment are generic. By suitable adjustmentof the associated cost factors, different interpretations can be accommodated. In fact, the Type III or IV test equipment teams could be used to represent equipment operators if it were desirable to account for operator costs in a particular computer run.

2.6 Modeling Assumptions

As previously noted, the LOCAM 5 model is mainly logistic support oriented and takes a detailed look at the maintenance aspects of cost after the equipment becomes operational. Acquisition costs including development, production costs per item of equipment and nonrecurring production costs are accounted as model inputs. The model does not compute these costs like the RCA PRICE model, which when input with a few facts about a proposed system or item of equipment, generates a printout of the likely development and manufacturing costs.

The LOCAM 5 model also assumes a homogeneous deployment of the support and supply echelons. This implies that the maintenance hierarchy is such that the workload arriving at a maintenance level (Direct Support, General Support, or Depot) is equally distributed between the maintenance facilities deployed at a particular echelon). Supply is also equally distributed to the number of supply points located at each echelon.

LOCAM 5 owes its ability to run rapidly on a computer to the fact that it is a deterministic model as opposed to simulation models which represent a system's behavior as a function of time. These latter classes of models are often complex. They generally employ Monte Carlo techniques and consume considerable computation time.

The LOCAM computer analyses generally assume a constant deployment such that the operational costs are the same for each year during the O&M phase. The inclusion of program "phase-in" would add considerable complexity to the model. However, if "phase-in" is important, it can be accommodated by successive computer runs to represent the yearly buildup of a deployment and increased equipment utilization.

2.7 Modeling Limitations

There are many advantages to LOCAM applications. These, however, are not panaceas that handle all problems of the system developer or user, nor are they without limitations. LOCAM studies must be examined to recognize the limitations built into them, or the premises generated based on "given" information.

The more prominent limitations inherent in analytical studies using LOCAM are as follows:

a) Accuracy of input data (particularly failure rate and equipment utilization data).

b) Improper data usage.

c) Inadequateproblem definition.

d) Interjection of bias.

e) Poor assumptions.

f) Failure to reappraise.

g) Future uncertainties.

The preceding limitations can be minimized by sensitivity testing because it increases visibility and permits factors to be refined and adjusted to show their significance on logistics support costs.

SECTION 3
PROGRAM STRUCTURE AND FLOW

3.1 Operational Flow Chart

In Figure 5 the operational flow of the LOCAM 5 program and its subprograms is depicted without regard to the division between the main program and its subprograms. Rather, as the name implies, Figure 5 shows the overall operation as a total program which performs the following functions:

a) Initializes values.

b) Resets accumulators.

c) Reads in "global" information (those data relevant to all items being examined).

d) Reads LRU related data.

e) Computes LRU related results.

f) Prints the results of LRU related results (if commanded).

g) Examines its internal logic to determine whether to print totals, add the LRU results to previous results for that LRU, read new LRU information, or return via the sensitivity portion of the program to modify old data.

The process, as depicted in Figure 5, is letter-keyed to correlate with the following descriptions:

a) Initialization of certain values: cumulative items are set to zero, some multipliers are set to zero (others to 1), controls are set to route the program along its initial path, and "global" information is read into memory.

b) The LRU related summary totals are set to zero.

c) Default values are set up for all inputs. The LRU related inputs are read (initially), and stored on tape for later recall, if desired.

d) The need for a sensitivity test is investigated.

e) The LRU whose data are currently in memory is exercised to determine demands imposed by that LRU (this LRU may be the one read from cards per previous Item c or the LRU recalled from tape via Item i which follows). These individual LRU results may be printed or not, as desired. At the end of the LRU group, a case total is printed.

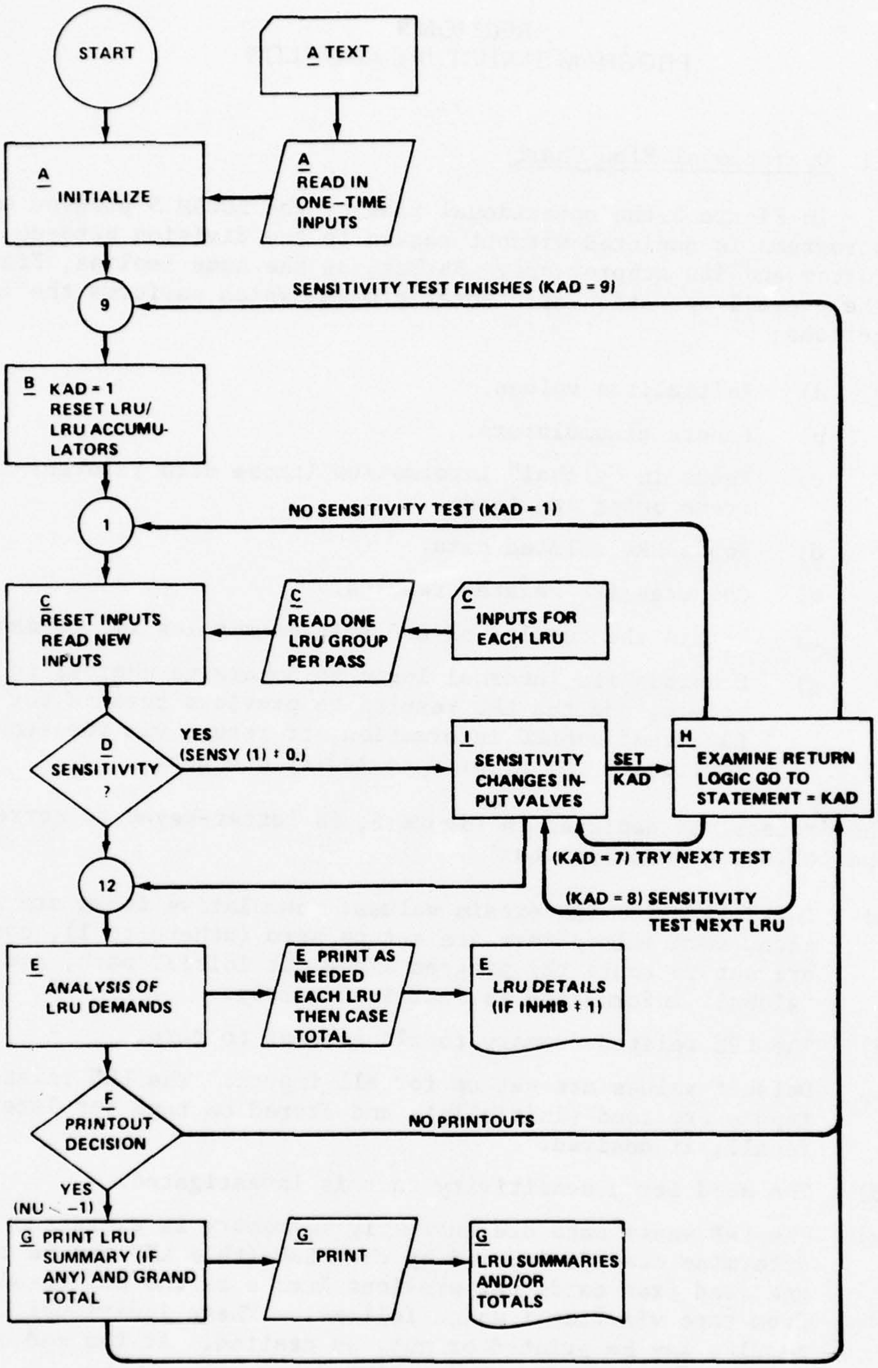


Figure 5. LOCAM 5 overall flow.

f) The need for a higher level of total output is examined.

g) The higher level of total output is printed (if F demands it) as are the LRU summaries, if required.

h) The internal logic is examined (the value of KAD is the determining factor) and the program may:

   1) Return to statement 9 (previous Item b).

   2) Return to statement 1 (previous Item c).

   3) Return to the sensitivity section of the program (Item i which follows).

i) If called upon, the sensitivity section will recall the next LRU data from tape, modify some of its values per rules input with the last reading of "LRU related data" noted in previous Item c.

Further flow charting and description will proceed as through the sensitivity testing does not exist. Sensitivity testing will be covered in Section 7.

3.1.1 <u>Details of Initialization Flow (Block "A" in Figure 5)</u>. This section of the program is merely a group of statements and the imposition of the BLOCK DATA values on the mnemonics of the COMMON/INPUT/ COMMON/SENSY. As such, it does not lend itself to conventional flow charts, but Figures 6 and 7 and Table 3 depict the relationships between the various mnemonics and the default values imposed.

Figure 6 expands Block A (in conjunction with Table 3) to introduce the initialization of values and their significance.

The BLOCK DATA section of the program sets up values for all variables included in the COMMON/INPUT. Table 3 shows that the ARA (for example) may, within LOCAM 5, be referred to by four different names -- ARA, SAV(1), SAVV(1), and SAVI(1), by SAVI(1) in "BLOCK DATA," by VAR(1) in the "SENSIT," and by ARA in "BASIC." BLOCK DATA, via data statements, sets up the values shown in Table 3.

Similarly, other items have more than one name. Table 4 shows the relationship between the names of COMMON/ZERO/and the Array CUM. The mnemonics of this list are used within LOCAM 5 but the equivalents (elements of Array CUM) are used in the transfer of data to and from the Array SUM. Each item in the COMMON/ZERO/ is an accumulator that collects all units (cost for example) related to it from each LRU examined. When the last LRU has been processed, the mnemonic's location contains the sum of that aspect of cost contributed by each LRU for the case being examined.

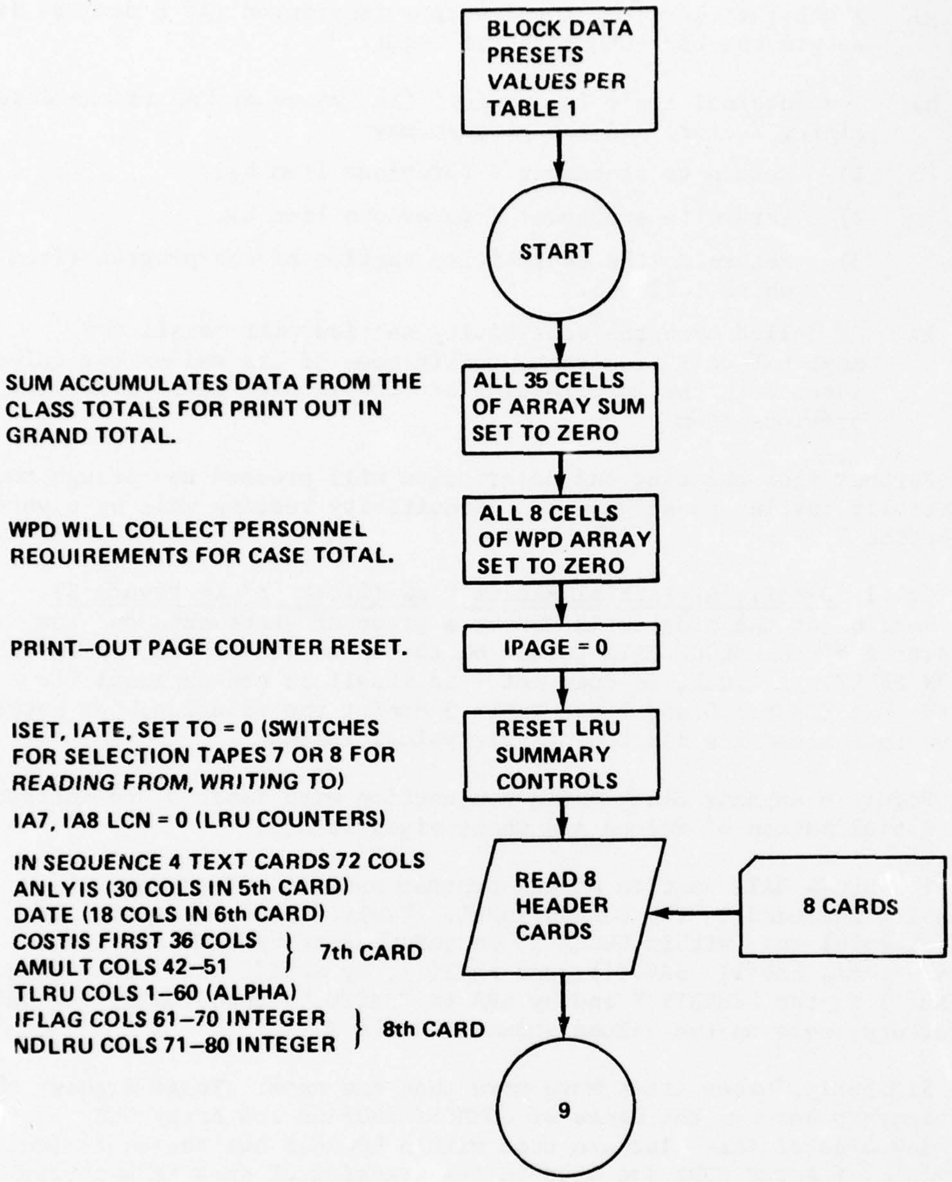


Figure 6. Initialization flow (Block "A" of Figure 5).

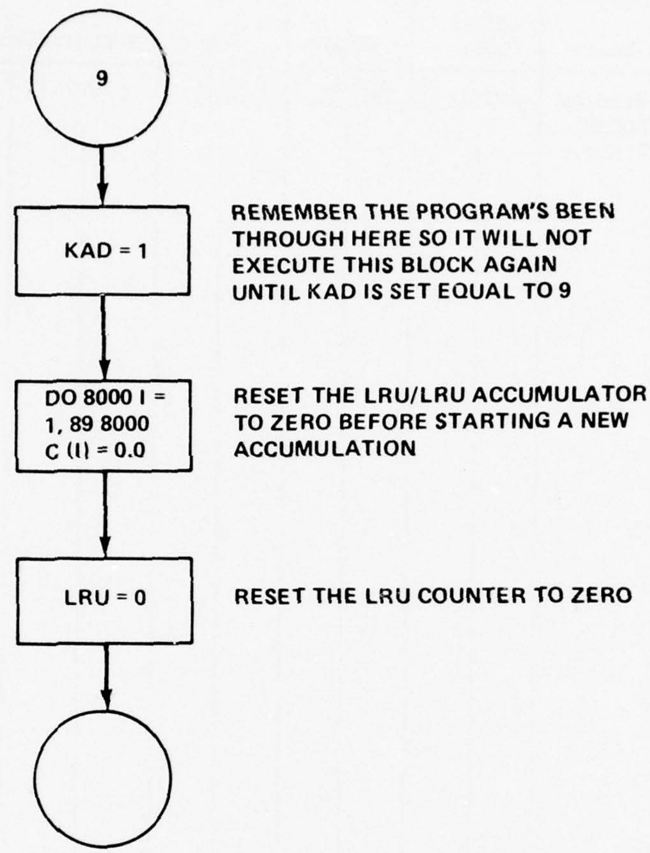


Figure 7. Remaining LRU/LRU (summary total) accumulators (Block "B" of Figure 5).

TABLE 3. EQUIVALENCE OF NAMES OF VARIABLES

Block Data Default Value	Common/Input				LOCAM 5 Equivalent Names		
	LOCAM 5	Basic	Block Data	SENSIT			
0.	ARA	Same as LOCAM 5 Names	SAVI(1)	VAR(1)	SAV(1)	SAVV(1)	SAVI(1)
1.	AYZP						
0.	CAD						
0.	CALMAN						
0.	CALPUB						
0.	CALSET						
0.	CCAL						
0.	CCALP						
0.	CCALR						
0.	CCSP						
0.	CCSPP						
0.	CCSPR						
0.	CDDI						
0.	CDEO						
0.	CDFD						
0.	CDID						
0.	CDIO						
0.	CDMAN						
0.	CDOE						
0.	CDOI						
0.	CDPMAN						
0.	CDPRMN						
0.	CDRMAN						
0.	CEN						
0.	CEND						
0.	CFTD						
0.	CGMAN						
0.	CGRMAN						
0.	CI						
0.	CII						
0.	CKIT						
0.	CKMD						
0.	CKMI						
0.	CKMO						
0.	CKPD						
0.	CKPI						
0.	CKPO						
0.	CKUD						
0.	CKUE						
0.	CKUI						
0.	CKUO						
0.	CLRUPG						
0.	CMODPG						
0.	CMP						
0.	CONMAN						
0.	CONTCT						
0.	CPE		SAVI(47)	VAR(47)	SAV(47)	SAVV(47)	SAVI(47)

TABLE 3. (Continued)

Block Data Default Value	Common/Input LOCAM 5	Basic	Block Data	SENSIT	LOCAM 5 Equivalent Names		
0.	CPI	Same as LOCAM 5 Names	SAVI(48)	VAR(48)	SAV(48)	SAVV(48)	SAVI(48)
0.	CPII						
0.	CPP						
0.	CPUBII						
0.	CRI						
0.	CRII						
0.	CRM						
0.	CRP						
0.	CRU						
0.	CSDEP						
0.	CSDSU						
0.	CSGSU						
0.	CTCPUB						
0.	CTRA						
0.	CTRCAL						
0.	CTRI						
0.	CTRII						
0.	CTSPT						
0.	CUBEM						
0.	CUBEP						
0.	CUBEU						
0.	CUCE						
0.	CUP						
1.	DAOQL						
1.	DD						
1.	DDS						
0.	DI						
0.	DIS						
0.	E						
0.	ED						
0.	EDS						
1.	EE						
1.	EVDM						
1.	EVDR						
0.	EVDT						
1.	EVIM						
1.	EVIR						
0.	EVIT						
1.	EVOM						
1.	EVOR						
0.	EVOT						
0.	FI						
0.	FII						
0.	FINT						
1.	FMD						
1.	FMI		SAVI(93)	VAR(93)	SAV(93)	SAVV(93)	SAVI(93)

TABLE 3. (Continued)

Block Data Default Value	Common/Input				LOCAM 5 Equivalent Names		
	LOCAM 5	BASIC	Block Data	SENSIT			
1.	FMO	Same as	SAVI(94)	VAR(94)	SAV(94)	SAVV(94)	SAVI(94)
0.	FN	LOCAM					
0.	FNGF	5 Names					
1.	FNSP						
0.	FSA						
0.	FTI						
0.	FTII						
0.	FTM						
0.	FTP						
0.	FTU						
1.	FUD						
1.	FUI						
1.	FUO						
0.	HPM						
0.	HPP						
0.	HPU						
0.	OD						
0.	ODS						
1.	OTF						
0.	P						
0.	PMR						
0.	PP						
0.	PRP						
0.	PUR						
1.	QMM						
1.	QMP						
1.	QMU						
0.	QTD						
0.	QTE						
0.	QTI						
0.	QTMD						
0.	QTMI						
0.	QTMO						
0.	QTO						
0.	QTPD						
0.	QTPI						
0.	QTPO						
0.	RDD						
1.	REPEAT						
0.	RID						
0.	ROI						
0.	SMD						
0.	SMF						
0.	SMI						
0.	SMO						
0.	SPR		SAVI(139)	VAR(139)	SAV(139)	SAVV(139)	SAVI(139)

TABLE 3. (Continued)

Block Data Default Value	Common/Input				LOCAM 5 Equivalent Names		
	LOCAM 5	BASIC	Block Data	SENSIT			
1.	SPEV	Same as	SAVI(140)	VAR(140)	SAV(140)	SAVV(140)	SAVI(140)
1.	SPEVR	LOCAM					
0.	SUD	5 Names					
0.	SUI						
0.	SUO						
0.	SVE						
0.	SVR						
0.	SVT						
0.	SVV						
0.	TALMAN						
0.	TATE						
0.	TC						
0.	TD						
0.	TDI						
0.	TDMAN						
0.	TDMW						
0.	TDPMI						
0.	TDPMII						
0.	TDPRI						
0.	TDPRII						
0.	TDR						
0.	TDRMAN						
0.	TEO						
0.	TF						
0.	TFR						
0.	TGMAN						
0.	TGRMAN						
0.	TI						
0.	TID						
0.	TIMW						
0.	TIO						
0.	TIR						
0.	TMD						
0.	TMDD						
0.	TMDR						
0.	TMI						
0.	TMID						
0.	TMIR						
0.	TMO						
0.	TMOD						
0.	TMOR						
0.	TOE						
0.	TOI						
0.	TOMW						
0.	TONMAN						
0.	TRC		SAVI(185)	VAR(185)	SAV(185)	SAVV(185)	SAVI(185)

TABLE 3. (Continued)

Block Data Default Value	Common/Input				LOCAM 5 Equivalent Names		
	LOCAM 5	BASIC	Block Data	SENSIT			
0.	TUMD	Same as	SAVI(186)	VAR(186)	SAV(186)	SAVV(186)	SAVI(186)
0.	TUMI	LOCAM					
0.	TUMO	5 Names					
168.	WD						
168.	WDM						
168.	WDR						
168.	WI						
168.	WIM						
168.	WIR						
0.	WM						
168.	WO						
168.	WOM						
168.	WOR						
0.	WP						
0.	WTKIT						
0.	WU						
0.	YAT						
0.	YD						
0.	YMWO						
0.	YP						
0.	YR						
0.	YZ						
.99999	ZFL						
0.	ZI						
0.	ZO		SAVI (210)				SAVI(210)
0.	H(1)		SAVA(1)				SAVA(1)
1.	H(2)						
1.	H(3)						
1.	H(4)						
0.	OL(1)						
0.	OL(2)						
0.	OL(3)						
0.	OST(1)						
0.	OST(2)						
0.	OST(3)						
0.	SL(1)						
0.	SL(2)						
0.	SL(3)						
0.	TAT(1)						
0.	TAT(2)						
0.	TAT(3)						
1.	TAYZ(1)						
1.	TAYZ(2)						
1.	TAYZ(3)						
1.	TAYZ(4)						
1.	TAYZ(5)		SAVA(21)	VAR(231)	SAV(231)	SAVV(231)	SAVA(21)

TABLE 3. (Continued)

Block Data Default Value	Common/Input				LOCAM 5 Equivalent Names		
	LOCAM 5	BASIC	Block Data	SENSIT			
1.	TAYZ(6)	Same as	SAVA(22)	VAR(232)	SAV(232)	SAVV(232)	SAVA(22)
1.	TAYZ(7)	LOCAM					
1.	TAYZ(8)	5 Names					
1.	TAYZ(9)						
1.	TAYZ(10)						
.99999	ZM(1)						
.99999	ZM(2)						
.99999	ZM(3)						
.99999	ZP(1)						
.99999	ZP(2)						
.99999	ZP(3)						
.99999	ZU(1)						
.99999	ZU(2)						
.99999	ZU(3)						
.99999	ZU(4)						
0.	STAT						
0.	DTO						
0.	DTI		SAVA(39)				SAVA(39)
0.	GA		SAVG(1)				SAVG(1)
0.	GB						
0.	GC						
0.	GD						
0.	GE						
0.	GF						
0.	GG						
0.	GH						
0.	GI						
0.	GJ						
0.	GK						
0.	GL						
0.	GM						
0.	GN						
0.	GO						
0.	GP						
0.	GO						
0.	GR						
0.	GS						
0.	GT						
0.	EACAL						
0.	EACSP						
0.	ETI						
0.	ETII		SAVG(24)				SAVG(24)
2	IO		JSAV(1)				SAVJ(1)
1	IS						
1	JTED						
1	NA						
1	NU		JSAV(5)	VAR(278)	SAV(278)	SAVV(278)	SAVJ(5)

TABLE 3. (Concluded)

Block Data Default Value	Common/Input				LOCAM 5 Equivalent Names		
	LOCAM 5	BASIC	Block Data	SENSIT			
0.	SAOY	Same as	SAVSA(1)	VAR(279)	SAV(279)		
0.	SAORY	LOCAM					
0.	SAIY	5 Names					
0.	SAIRY						
0.	SADY						
0.	SADRY						
0.	CAOY						
0.	CAORY						
0.	CAIY						
0.	CAIRY						
0.	CADY						
0.	CADRY		SAVSA(12)	VAR(290)	SAV(290)		

TABLE 4. EQUIVALENCE OF NAMES OF ACCUMULATOR VARIABLES

COMMON/ZERO/ List Name	Array CUM Equivalent	COMMON/ZERO/ List Name	Array CUM Equivalent
CCET	CUM (1)	HPD (1,1)	CUM (36)
CCTS	(2)	HPD (1,2)	(37)
CCTSR	(3)	HPD (2,1)	(38)
CCF	(4)	HPD (2,2)	(39)
CCM	(5)	HPD (3,1)	(40)
CCMF	(6)	HPD (3,2)	(41)
CCMD	(7)	HPD (4,1)	(42)
CCMFD	(8)	HPD (4,2)	(43)
CTRF	(9)	CAYZ (1)	(44)
CTRDEP	(10)	(2)	(45)
CTR	(11)	(3)	(46)
CIV	(12)	(4)	(47)
CIVREC	(13)	(5)	(48)
CRT	(14)	(6)	(49)
CWH	(15)	(7)	(50)
CSA	(16)	(8)	(51)
CSAREC	(17)	(9)	(52)
CSH	(18)	CAYZ (10)	(53)
CGT	(19)	CAYZI (1)	(54)
CTREC	(20)	(2)	(55)
PCD	(21)	(3)	(56)
QCTU	(22)	(4)	(57)
PCP	(23)	(5)	(58)
CQTM	(24)	(6)	(59)
PCR	(25)	(7)	(60)
CQTP	(26)	(8)	(61)
PCS	(27)	(9)	(62)
CQTUMP	(28)	CATZI (10)	(63)
PCGT	(29)	PERS (1,1)	(64)
SEMPT	(30)	(1,2)	(65)
SEPC	(31)	(2,1)	(66)
SPCR	(32)	(2,2)	(67)
SEPV	(33)	(3,1)	(68)
SDEL	(34)	(3,2)	(69)
SPDEL	CUM (35)	(4,1)	(70)
		PERS (4,2)	CUM (71)

NOTE: This sum will be later accumulated in the Array CUM by using its pseudonym. Thus, instead of writing thirty-five equations like SUM(1) = SUM(1) + CCET, a single equation is written as SUM(I) = SUM(I) + CUM(I) and executed for each value of I from 1 to 35. Because CCET and CUM(1) are identical, the result is the same in both cases.

When the program sets all thirty-five cells of Array SUM to zero (Figure 6), it is clearing its grand total accumulators.

Similarly, WPD, the test and repair facility usage is set to zero.

To this point, all values have been set via data statements (non-executable statements). Now, however, through executable statements, the program resets the page counter (IPAGE) and all of the controls for accumulating LRU summary data to zero. In summarizing LRU data, the program will later write all data relative to each LRU on tape No. 7. After printing the case total, the LRUs will be reprocessed in a new situation and, as each LRU is processed, the information from the previous pass is retrieved from tape No. 7, added to the present data and written on tape No. 8. If necessary, the process may be repeated without limit, reading from tape No. 8 and writing on tape No. 7 on the next accumulation. Thus, the controls must be set to zero prior to the start of execution to assure a correct start.

ISET = 0 and IATE = 0 reset the switches that select the tapes.

IA7 = 0 and IA8 = 0 reset the counters that keep track of how many LRUs have been stored on tapes No. 7 and 8, respectively.

ICN = 0 resets the LRU counter for the first write pass.

Rewind No. 7, rewind No. 8 assures that both tapes are ready.

The program now reads eight cards (or records). The first four cards may each contain 72 columns of alphanumeric information called "TEXT" to be printed at the top of each page.

Card No. 5's first 30 columns may contain 30 alphanumerics for further identification (mnemonic name is "ANLYIS").

Card No. 6 contains "DATE" in the first 18 columns.

Card No. 7 contains two types of correlating information. In Column 1-36, the program expects to see 36 characters of alphanumeric information that will print out immediately following the words "COST IN" on each page of output. Thus, the 36 characters must identify the units of cost (hundreds, thousands, million of dollars). The 36 characters

chosen must be consistent with the value chosen for Column 42-51 (mnemonic "AMULT"). AMULT is a 10-character floating point (F10.5) value that multiplies dollar costs to obtain AMULT units (if cost is to be in "HUNDREDS OF DOLLARS," AMULT must be 0.01 or its equivalent).

The eighth card (or record) contains "TLRU" which may contain up to 60 alphanumeric characters to be printed on each LRU summary page. The next 10 characters of the card (record) contain "IFLAG." If IFLAG is blank or zero (it must be an integer), the program will accumulate and printout (eventually) a summary of each LRU in which the values printed represent the sum of all corresponding values for that particular LRU in all of its previously analyzed situations (cases). The next 10 columns contain an integer, NDLRU, which "...is the number of distinct LRUs for which a total is to be made over all cases in a concept."

3.1.2 Reset of the LRU/LRU (Summary Total) Accumulators (Block "B" of Figure 5). Figure 7 shows the flow associated with the reset of the LRU/LRU accumulators. On the first pass, it is desirable to execute this block in which the accumulators [Array C (I) in which I may range from 1 to 89] are set to zero. This is accomplished with a "DO" statement which commands Statement 8000 to be performed with all values of I of 1 through 89. Statement 8000 reads:

```
8000 C(I) = 0.
```

It is noted (per Figure 5) that this statement will not be executed again until it is desirable to begin again (that is, when a sencitivity test is finished). Also, the LRU counter is reset to zero.

3.1.3 IS Input Control (Block "C" of Figure 5). Block "C" resets inputs and reads new values into memory that are peculiar to the current LRU. Figure 8 is the graphic representation. In Figure 8, the flow chart depicts the decisions to be made regarding the resetting of certain items prior to the beginning of each LRU pass (it is noted that from Figure 5 this flow chart falls entirely within the loop processed for each LRU). Since prior to reading in any contradictory data IS=1 and NB=0, these values set up the path for the first pass so that:

a) All values of OSAV(I) are entered into SAV(I). These are two arrays of 290 possible values. This permits saving the previously saved (in OSAV) values if desired. (On the initial pass this is of no value).

b) IS=3 so that this route cannot be passed through again.

c) The maintenance policies are set to zero (G(I) = 0).

d) The first 43 values of COMMON/ZERO/ are set to zero (Table 4) as is the value of PERS (1,2). These are values that will be computed later by addition into these cells, hence they must start as zero.

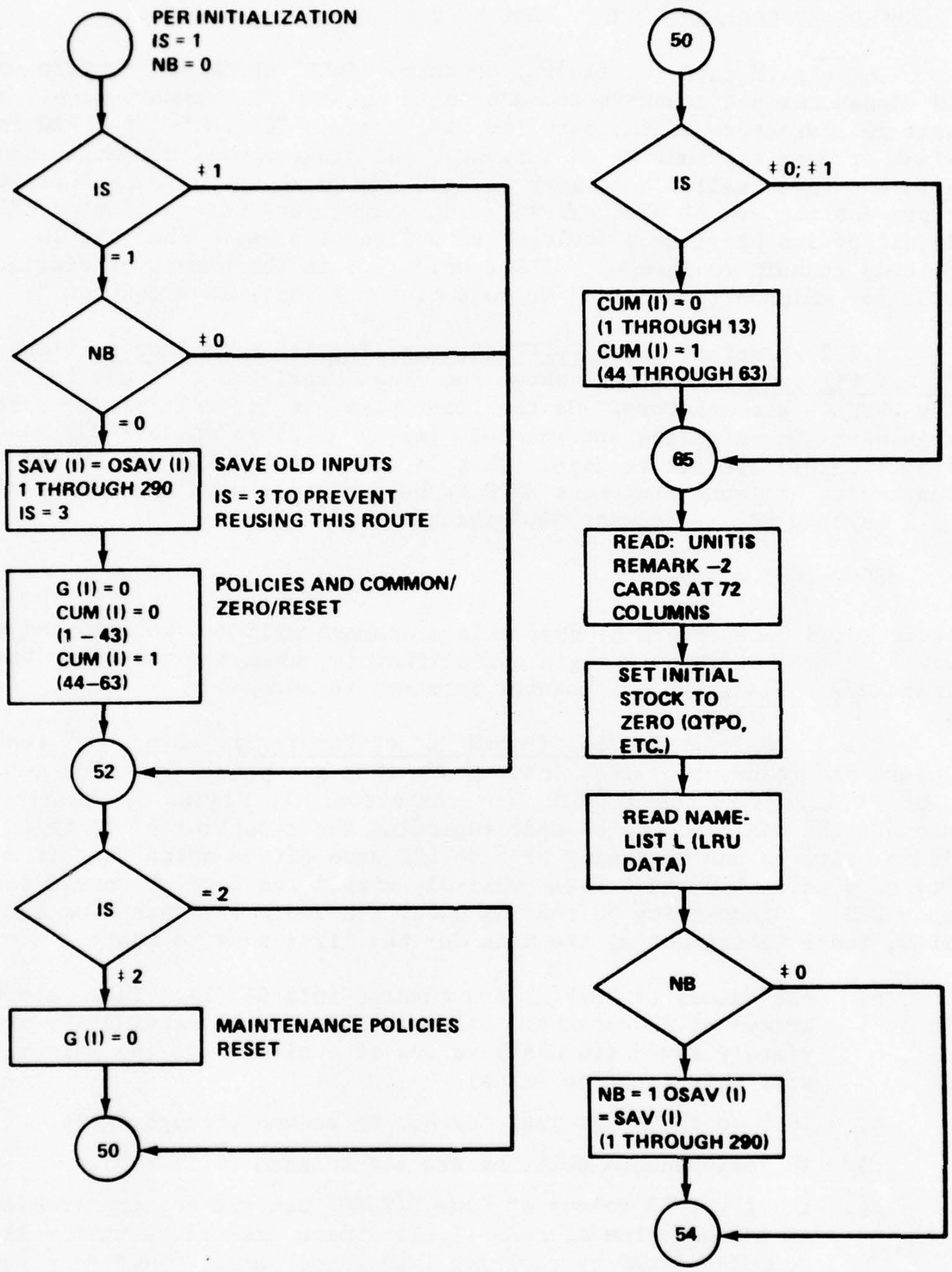


Figure 8. IS input control (Block "C" of Figure 5).

e) The next 20 values of COMMON/ZERO/ (per Table 4) represent values that are obtained by multiplying their initial values by computed values. Therefore, these values are initialized to equal 1.

f) The maintenance policies (G(I)) are again set to zero (this occurs only on the first pass).

The next pass will experience only one resetting of the maintenance policies (G(I)) to zero since IS now equals 3. It is noted that all of this is in agreement with the description of IS in Appendix B, namely:

a) If IS = 1, all inputs used for the first LRU of the deck are recalled for use with the next LRU (SAV(I) = OSAV(I)) and the accumulators are reset (CUM(I)).

b) If IS ≠ 2, maintenance concepts are reset.

c) If IS = 2, maintenance concept is retained from one LRU to the next.

d) If IS = 3, all reset actions are neutralized.

e) Again CUM(I) (I = 1 through 43) are set to zero and CUM(I) (I = 44 through 63) are set to one (see above). This repeat occurs only on this first pass.

f) UNITIS and REMARK, two successive cards are read. Each has 72 columns of data for later printout. Each is related to the LRU under consideration.

g) Initial stock of all items (LRUs, modules, parts) at all possible locations. E(Equipment), F (Direct Support), I(General Support), and D(Depot) are set to *zero*. That is, QTE, QTO, QTI, QTD (LRUs); QTMO, QTMI, QTMD (modules); and QTPO, QTPI, QTPD (parts) are set to zero.

h) All data relevant to the LRU and its environment that are different from those of the previous LRU are read via NAMELIST/L/.

i) NB is set equal to 1 to prevent accidentally following this initial path and the data of COMMON/INPUT/ (as modified by the NAMELIST/L/inputs) are saved for possible recall on the next pass by OSAV(I) = SAV(I) since (Table 3) SAV(I) is the COMMON/INPUT/data.

Unless IS and NB were set to some other value when the NAMELIST/L/ data were read, the next pass will experience only IS=3, and NB=1. This combination will permit only the resetting of policies (G(I) = 0), the reading of UNITIS, REMARK, and the reading of the NAMELIST/L/ data as noted in Appendix B. IS need not actively be set to 3 because it is

internally set to that value, but it must be permitted to be = 3 to assure correct accumulator function. Similarly, IS = 2, IS $\neq$ 2 and IS = 1 operate as described in Appendix B.

Figure 9 shows a control section for summarizing LRU data (Section 3.1.1).

Inspection of the value of IFLAG determines whether or not such summarization is to take place. If IFLAG > 0, no summarization takes place and the program skips the controls. If IFLAG is zero, blank, or negative; the value of ICN (originally set to zero) is incremented each pass so ICN's value is the sequence number of the LRU within the LRU group. When ICN has counted to the number of the last LRU, it is equal to the value input as NDLRU. On the next pass, incrementing ICN makes ICN > NDLRU so it is set = 1 (ICN = 1) to keep in step with the LRUs.

On each summarizing pass, the value previously read in as UNITIS is stored in the array UNS (1 through 3).

Examination of NU at this point determines whether the analysis is complete (if NU = -4) or should proceed (if NU $\neq$ -4).

3.1.4 Control of Scratch Tape (Block "D" of Figure 5). Block "D" of Figure 5 is necessarily simplified. As expanded in Figure 10, it can be seen that the examination of "SENSY (1)" is only a small portion of what really occurs. It is however the most significant action of this portion of the program.

SENSY (1) is the value read in from NAMELIST/L/ as "SENSY." This is the result of an inherent characteristic of the use of "NAMELIST" as an input device. That is, if the name of an array appears in a NAMELIST, any unsubscripted reference in that array is automatically the first element of the array. SENSY is an array and is so defined by a COMMON statement in the program.

"COMMON/SENS/SENSY (266),..."

Thus SENSY is an array of 266 elements. When "SENSY=" appears in the NAMELIST input, the first value detected is assigned to SENSY (1).

In Figure 10, the block setting H(I) = 1. is a type of flag setting operation. If the NAMELIST inputs had determined that LRUs would be initially stocked at Equipment, QTE would be set to some value other than zero (at least = 1). In the block of Figure 10, in this case, if QTE is greater than or equal to 0.5 then H(1) = 1. That is, if initial stock of LRUs is to be assigned to the Equipment level H(1) = 1.0. Similarly:

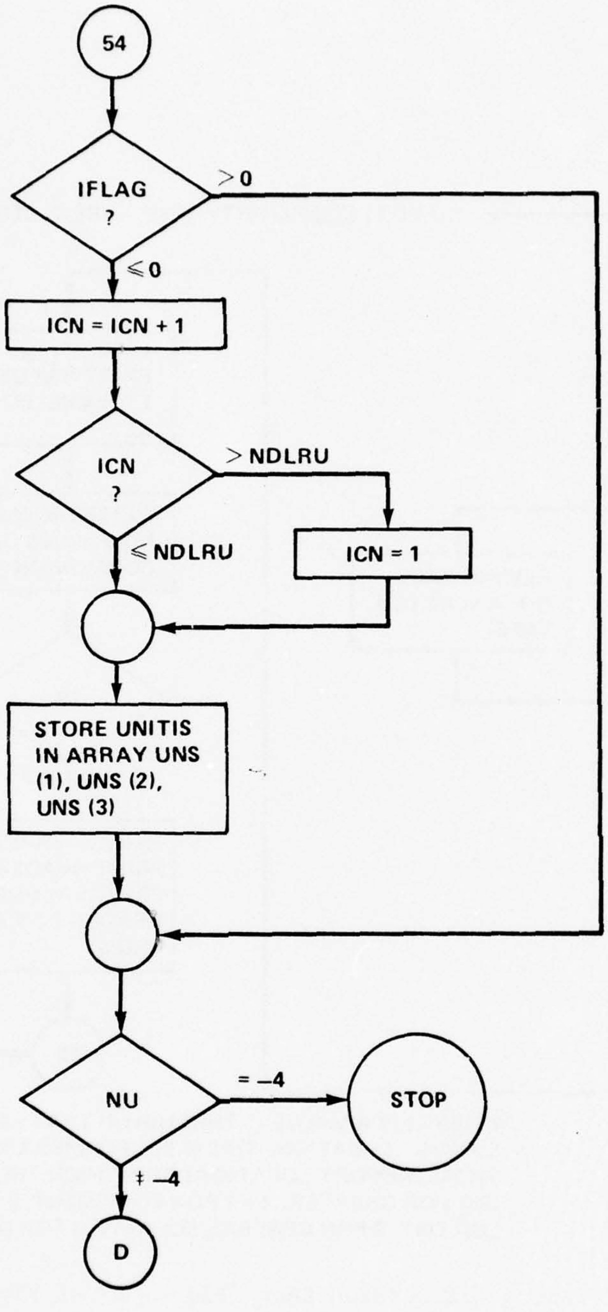
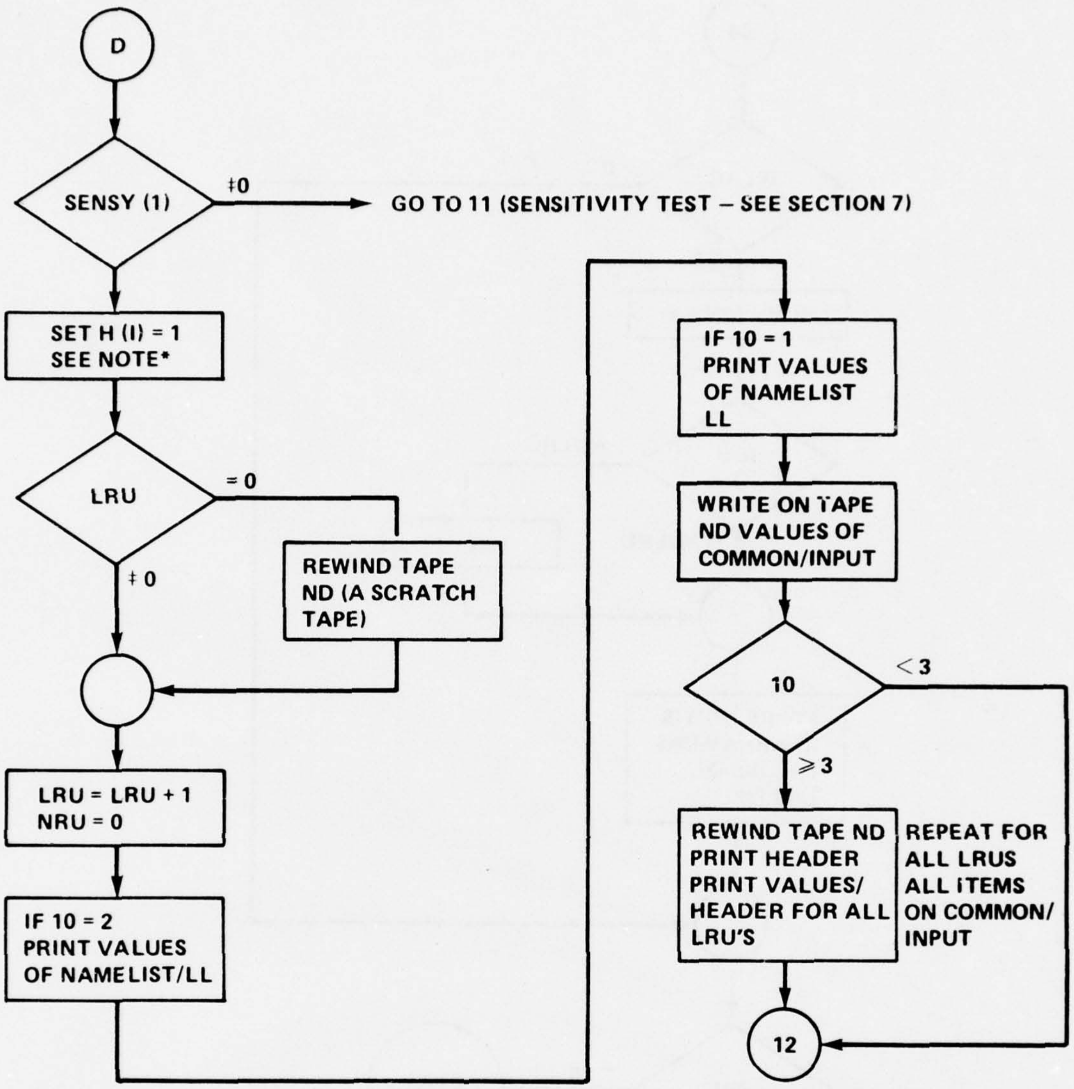


Figure 9. Control of summary total accumulation (Block "C" of Figure 5).



*WHERE I IS A VALUE (1 THROUGH 4) THAT REPRESENTS A SUPPORT LOCATION. THIS IS PERFORMED ONLY FOR THOSE SUPPORT LOCATIONS FOR WHICH THE LRU STOCK IS 0.5 OR GREATER. I = 1 FOR EQUIPMENT, 2 FOR DIRECT SUPPORT, 3 FOR GENERAL SUPPORT, 4 FOR DEPOT.

Figure 10. Control of scratch tape (Block "D" of Figure 5).

a) For initial LRUs at Direct Support, QTO > 0.5 and H(2) = 1.

b) For initial LRUs at General Support, QTI > 0.5 and H(3) = 1.

c) For initial LRUs at Depot, QTD > 0.5 and H(4) = 1.

The remainder of Figure 10 is involved with writing the inputs on a scratch tape named "ND," with writing (on the printer) the LRU input values (if IO = 1 or 2); with writing the entire contents of the tape "D" if IO = 3. It is noted that the entire "D" block occurs outside the sensitivity loop of Figure 5 so that the sensitivity operation cannot alter the values of the original NAMELIST inputs (the sensitivity loop of Figure 5 includes only Blocks E, F, G, H, and I).

3.1.5 Fundamental Computational Flow and Accumulation of LRU Output (Block "E" of Figure 5)

3.1.5.1 Discussion of Figure 11. Block "E" of Figure 5 contains all of the equations and operations in which the demands that each LRU type makes on the support system and the costs consequently incurred are calculated. A detailed description of this operation is beyond the scope of this section, but will be found in Sections 4 and 6 of this manual. For now, it is sufficient to state as shown graphically in Figure 11 that Block E performs the following:

a) Computes the basic flow (on a per LRU per hour basis).

b) Calls "BASIC" twice -- once to compute the basic flow's shipping cost rates (through the supply "pipelines") and once to compute the basic flow's pipeline contents (of LRUs, modules, parts).

c) Summarizes the basic LRUs "down" and then computes inherent availability of the LRU. The "basic" values are then modified to reflect the actual environment (total deployed).

d) Depending on the value input for AYZP, the spare quantities are computed according to:

   1) MIRADCOM maintenance rules (Section 6).

   2) LOCAM rules via subroutine IOL (Section 6).

   3) Spare quantities are input values.

e) Computes the "back order quantity" (the number of LRUs "down" because of lack of supply). Demand for spares is then modified if operational availability is not up to the specified level. This may "loop" up to 10 times.

f) Computes final quantities and costs. These are summed into the LRU group cumulative figures (the array CUM (1-71) is the same as the value found in COMMON/AERO/CCET, etc.).

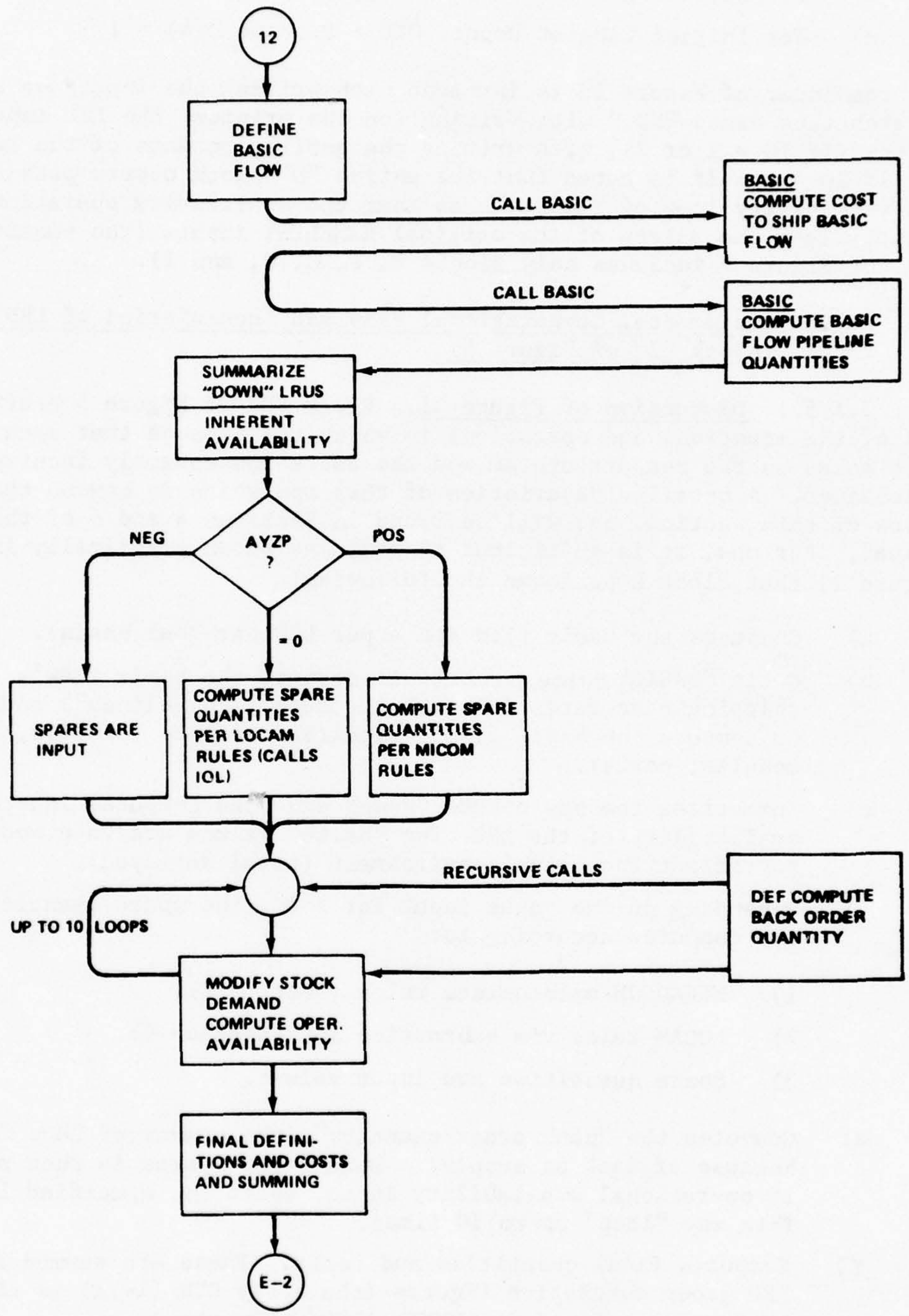


Figure 11. Fundamental computational flow (Block "E" of Figure 5).

3.1.5.2 Discussion of Figure 12. As each LRU's contribution to demand and cost is computed, the following are considered:

a) It is remembered (if IFLAG was not read in as a value greater than zero). The values are recorded on Tape No. 7 on the first pass of the LRUs. If more than one pass of all LRUs is being analyzed (the same LRUs deployed differently for example) then on even-numbered passes the previous history is read back from Tape No. 7, added to the current data for the LRU, and stored on Tape No. 8. On odd-numbered passes (other than the first) as each LRU is processed, its previous data are read from Tape No. 8, added to the current data, and re-recorded on Tape No. 7.

b) If individual LRU details are to be printed, (INHIB $\neq$ 1 or this is the last LRU before a total) the subroutine PAGE is called to turn the page (increment page number) and to print the page number and header (TEXT, etc.).

c) If SENSY $\neq$ 0, this is a sensitivity output and must be so labeled with the changed inputs identified and their current values noted (calling subroutine SENSIT).

d) The details related to the individual LRU currently being examined are printed.

3.1.6 Control of Printing of Totals (Blocks "F" and "G" of Figure 5). The logic of Blocks "E," "F," and "G" is so interwoven that complete separation is impossible at any level more detailed than that shown in Figure 5. Of the three blocks, "E" is most successfully isolated but even there the logic of the decision of whether more than one level of total is printed spills over into Blocks "F" and "G."

Blocks "F" and "G," which in Figure 5 depict the decision to print a higher level total and to print the summary pages for the LRU, are shown in Figure 13, "F"/"G". The figure does not show how every decision is made, merely what decisions are made.

The first decision that must be made is whether there will be any totals at all. If NU is not negative, control transfers to Block "H" of Figure 5; no totals are to be printed. If NU is -1 or -2, however, the IFLAG value is interrogated.

If IFLAG is greater than zero, no LRU summaries have been requested and control skips to Statement 8011. If LRU summaries have been requested (IFLAG $\leq$ 0), it is necessary to know if it is now time to print them. This decision is based on examining the value of an operation on an internal flag called "PRINT-1" which may be zero at the time of interrogation only if:

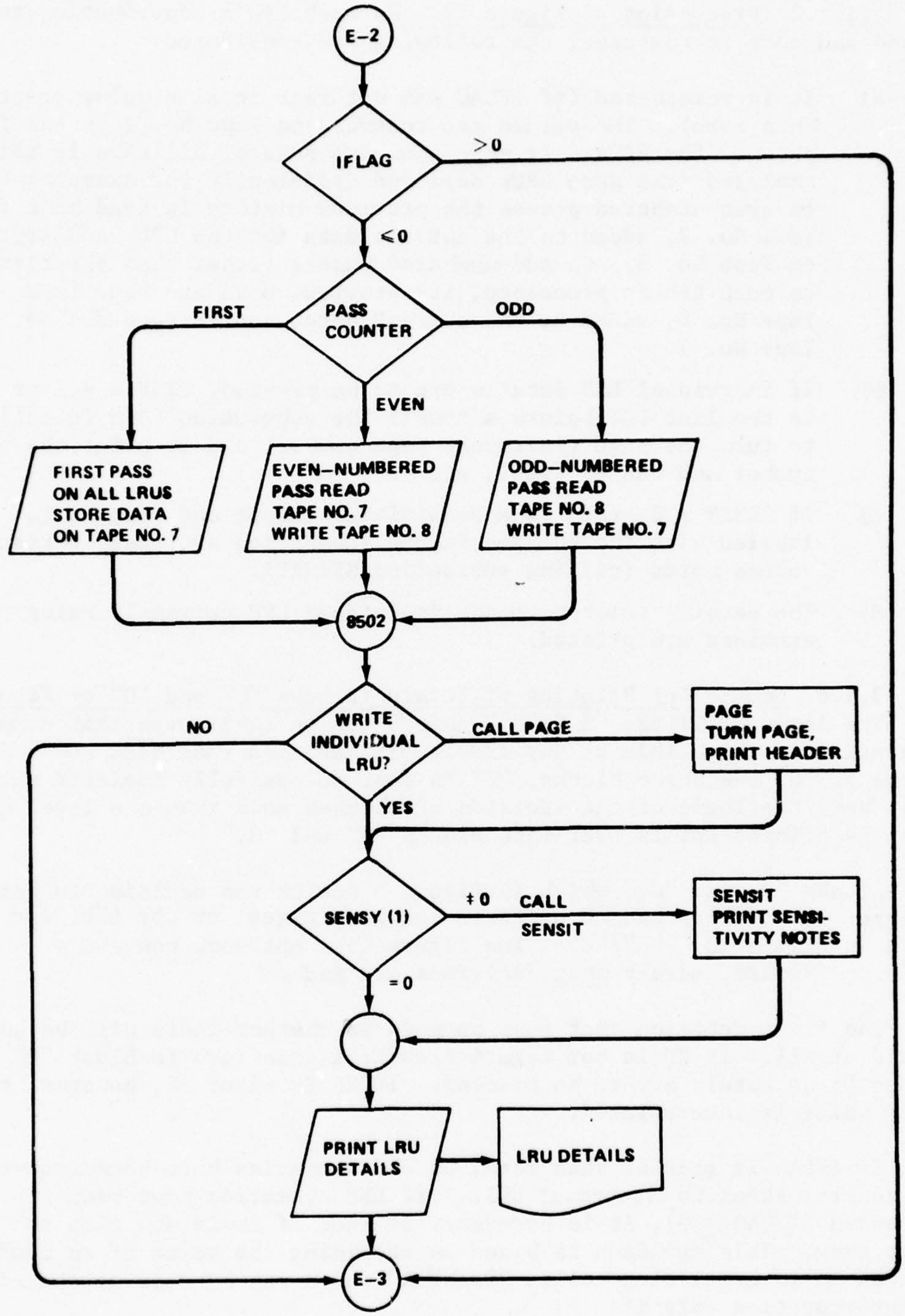


Figure 12. Control of accumulation recording and printing (Block "E" of figure 5).

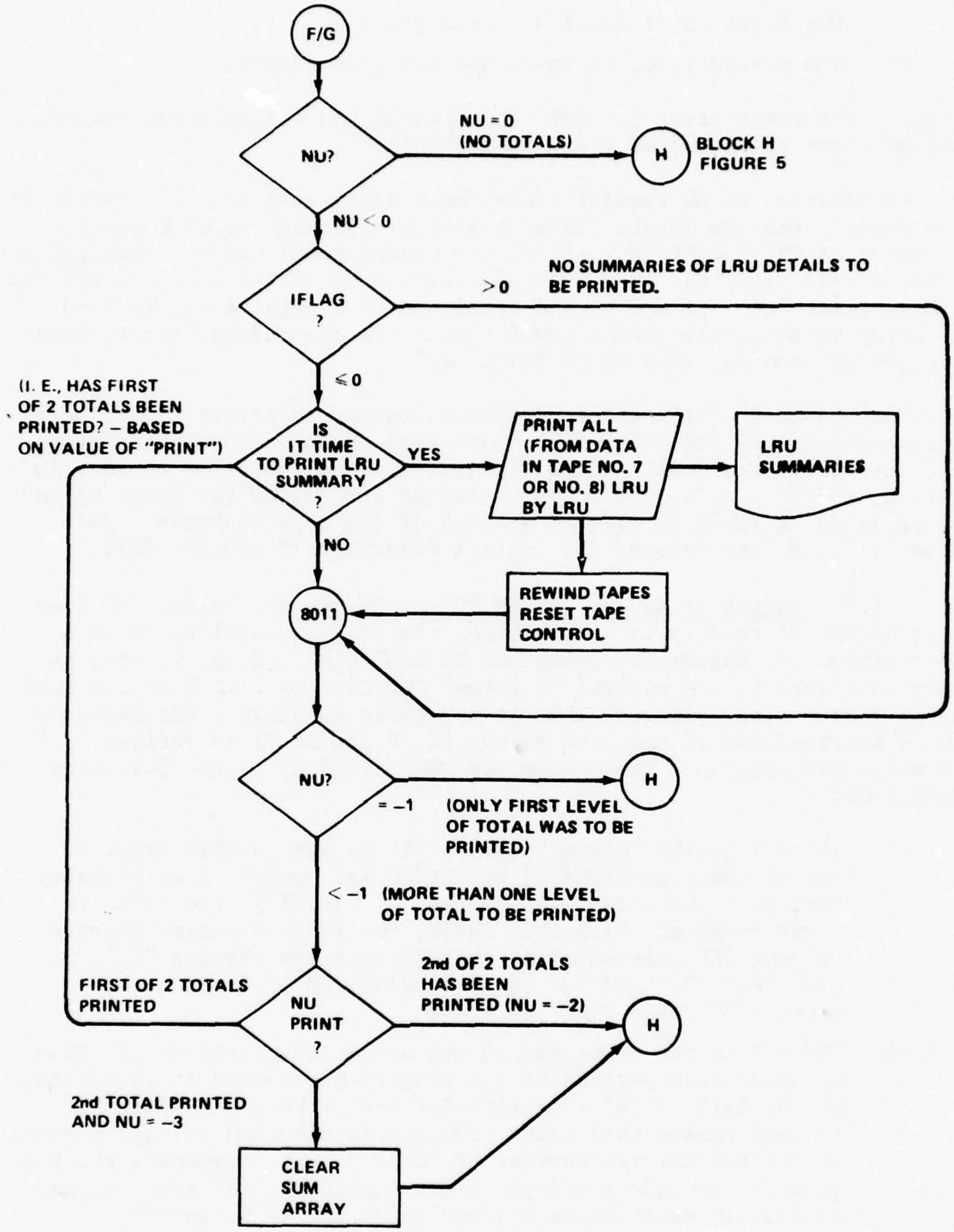


Figure 13. Control of printing totals (Blocks "F" and "G" of Figure 5).

a) More than one level of total is to be printed.

b) The first total level has been printed.

c) The second level of total has not been printed.

If the first total level has not been printed, the entire total page is printed (from the items of the COMMON/ZERO/).

Examination of NU (again) sends the program to Block "H" control if NU = 1 (only the one level of total was to be printed) or to reexamine the value of PRINT-1 if NU < -1 and the second total has not been printed. If the second total has been printed, a value of -2 for NU sends control back to Block "H." If the second total has been printed but NU = -3, the array in which the second level totals are accumulated (array SUM) is reset and control returns to Block "H."

The printing of the LRU summaries (between the printing of totals) is accomplished by remembering the last tape on which the LRU details were recorded. The tape (called ITAP) is rewound, each LRU summary is printed, the data array (C) of dimension 89 from which the printing is accomplished is reset to zero as are all of the tape controls. Both tapes (7 and 8) are rewound and control returns to Statement 8011.

3.1.7 Control of Return (Block "H" of Figure 5). Block "H" does not lend itself readily to diagramming. In actual practice, it is a distribution of statements saying "GO TO KAD" (1, 7, 8, or 9) and, as shown in Figure 5, the control is indeed returned to 1 or 9 as required and to 7 or 8 also, although that is not quite so clear. The mnemonic KAD is assigned one of the four values (1, 7, 8, or 9) at various places in the program. The values are set according to the following conditions:

a) KAD = 1 is the "normal" value. It is set to this value as one of the operations of Block "B" and, unless a sensitivity test is to be performed (Blocks "D" and "I"), the value is never changed. With this value, the program passes through "A" and "B" only once and thereafter loops through "C," "D," "E," "F," "G," and "H" until it finds NU = -4 which will cause a "FORTRAN STOP" to occur.

b) KAD = 7 is the value set in the sensitivity portion of LOCAM 5 whenever that portion of the program determines it is working on the last LRU of a sensitivity test. When the Block "H" control senses this value, control is returned to that portion of the sensitivity section of LOCAM 5 that increments the pass counter, rewinds the input tape, resets the LRU counter, and eventually establishes the new parameter to be varied.

c) KAD = 8 is the value set by the sensitivity section LOCAM 5 on each initial loop-through of a new parameter. This value

remains set until the last LRU is processed for that parameter. When control is returned to Statement 8 (on sensing this value of KAD), the LRU counter is incremented to cause processing of the next LRU on the previously selected parameter variation.

d) KAD = 9 is set only when the last LRU is being processed during the last parameter variation. The result is that control is returned to Statement 9 to permit the resetting of accumulators, the reading in of new data or (more generally) a STOP (by reading a NU = -4 value).

3.1.8 Sensitivity (Block "I" of Figure 5). Block "I" involves sensitivity testing or the changing of input parameters in a specified manner (substitution of a new value, the addition or subtraction of a new value, or the multiplication or division by a new value). The changes are applied to the specified parameter for all LRUs read in to date and may be varied for further passes on all the LRUs. The method and purposes of performing such testing are discussed in detail in Section 7.

SECTION 4
PRINCIPAL MATHEMATICAL FORMULATIONS

This section expands on the description already presented in 3.1.5, following the growth of information about an LRU from the known inputs to the data representative of a single LRU location.

4.1 FLOW (All Equations Are in FORTRAN Notation)

As shown in Figure 14, the LRU is located in an environment known as E (for equipment). Because there are ED installations and EE identical LRUs per installation, there are EDEE = ED*EE *total LRUs to be* supported. The contributors to flow (through the pipelines and/or the test and repair facilities are as follows:

a) Quantity to be supported by the pipeline and/or facility.

b) Failure rate (E failures per hour per LRU).

c) False failures ratio (FNGF false failures per LRU per hour per real failures per LRU per hour). This is thus a dimensionless fraction.

d) Attrition -- YAT the fraction of the deployed that are attrited (disappear) each year.

All of the preceding contribute to the flow in the pipeline from the installation but before using them, they must all be converted to the same dimensions: *LRUs per hour per installation.* Thus, failures become the product of failures per LRU per hour times the number of (this type) LRU per installation, namely:

F = E*EE (Failures).

FNG = FNGF*F (false no-go's).

A = (YAT/8766)*EE (attrition)
(This last because YAT is a yearly number and there are 8766 hours per year).

FMWO = YMWO/8766 (the yearly rate of maintenance work orders converted to an hourly figure). This creates down time and work (and flow of kits).

TU, the sum of failures, false no-go's, and attrition, is obtained by the summation TU = A+F+FNG.

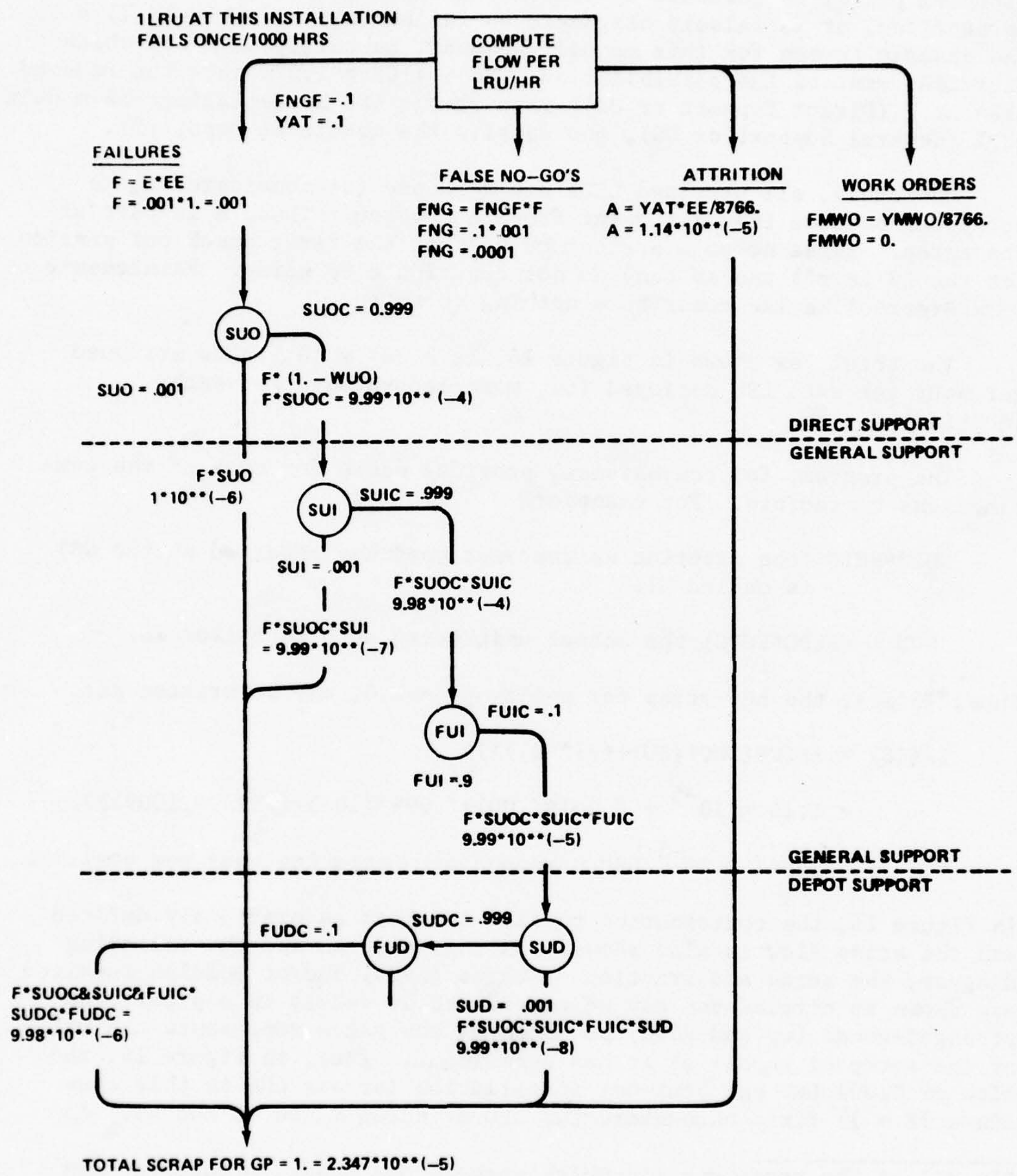


Figure 14. Scrap of LRUs for policy GP=1.

4.2 Scrapped LRUs (Figure 14)

The LRUs scrapped are computed for each possible maintenance policy (Section 5). Each policy inherently has its own scrap. For example, policy GA (discard on failure) scraps everything that fails, is attrited, or is falsely diagnosed as failed (FNGs). Thus TS(1) = TU. The example chosen for this manual, however, is policy GP = 1.0 which exercises most of the possibilities. Policy GP = 1.0 checks the removed LRUs at F (Direct Support or DS), repairs the LRU by replacing the module at I (General Support or GS), and repairs the module at Depot (D).

Obviously, all attrited LRUs are scrapped (or considered to be scrapped) because they disappear from the system. Thus, A is part of the scrap. False no-go's are turned back at the first check out station (at the DS level) and so they do not contribute to scrap. Maintenance Work Orders likewise contribute nothing to scrap.

The total, as shown in Figure 14, is 2.347×10^{-5} LRUs scrapped per hour for each LRU deployed (or, more accurately, for each location).*

The program, for convenience, provides names for some of the combinations of factors. For example:

SUIC*FUIC (the fraction neither scrapped nor repaired at the GS) is called BI.

SUD + (SUDC*FUDC) the actual unit scrap at D is called SD.

Thus, TS(16), the LRU scrap for policy GP = 1.0, may be written as:

TS(16) = A+(F*(SUO+(SUI+(BI*SD))))

$= 1.14 \times 10^{-5} + (.001*(.001+(.999*(.001+(.0999*.1009)))))$

$= 2.347 \times 10^{-5}$ LRU scrapped per operating hour per position.

In Figure 14, the contribution to flow is shown as previously defined and the scrap flow is also shown. In this diagram and the following diagram, the scrap and fraction of units (LRUs) and/or modules repaired are shown as circles and may be considered as valves in a pipe. The straight-ahead (up and down) position of the valve represents the value of the scrap or repair as it has been input. Thus, in Figure 14, the flow of 0.001 LRU per hour per installation (or per LRU in this case since EE = 1) first encounters the SUO or scrap valve at the DS. As

*In all of the equations (in which numbers are used), a failure rate of 1 per thousand hours, 1 LRU per installation, a false failure rate of 1 in 10, an attrition rate of 0.1, a scrap rate of 1 in 10, and repair rates of 9 in 10 have been assumed.

noted on the figure, only one in a thousand LRUs are (directly) scrapped at DS and so $0.001 \times 0.001 = 1 \times 10^{-6}$ LRUs per hour per LRU deployed trickle through this pipe. However, the rest of the flow into the valve must go somewhere. One-one thousandth (0.001) of the input flow is scrapped and 1-0.001 = 0.999 is not scrapped. This number is the complement of SUO and is therefore given the mnemonic name of SUOC.

Similar names for similar meanings are used hence with all scrap fractions set at 0.001 and all repair fractions set at 0.9.

SUOC = 1.-SUO = 0.999
SUIC = 1.-SUI = 0.999
SUDC = 1.-SUB = 0.999
SMOC = 1.-SMO = 0.999
SMIC = 1.-SMI = 0.999
SMDC = 1.-SMD = 0.999

FUOC = 1.-FUO = 0.1
FUIC = 1.-FMI = 0.1
FUDC = 1.-FMD = 0.1
FMOC = 1.-FMO = 0.1
FMIC = 1.-FMI = 0.1
FMDC = 1.-FMD = 0.1

Examination of Figure 14 shows that LRU scrap is the sum of the following:

a) A (attrition of 1.14×10^{-5} per LRU per hour).

b) $F*SUO = 1 \times 10^{-6}$ (scrapped at DS).

c) $F*SUOC*SUI = 9.99 \times 10^{-7}$ (failures not scrapped at DS but scrapped at GS)

d) $F*SUOC*SUIC*FUIC*SUD = 9.99 \times 10^{-8}$ (failures not scrapped at DS or GS, not fixed at GS and scrapped at Depot.

e) $F*SUOC*SUIC\&FUIC*SUDC*FUDC = 9.98 \times 10^{-6}$ (not scrapped at any level, but never repaired either)

4.3 Hourly Demands for Service

The demand for service is computed in terms of the incoming flow to a particular service facility per clock hour per LRU deployed and may include the following flows:

a) TUFOC [LRUs through the checkout-only facility at "F" (Direct Support)].

b) TUFOF [LRUs through the checkout/repair facility at "F" (Direct Support)].

c) TUFI [LRUs through the checkout/repair facility at "I" (General Support)].

d) TUFD [LRUs through the checkout/repair facility at "D" (Depot)].

e) TMFO [Modules through the module repair facility at "F" (Direct Support)].

f) TMFI [Modules through the module repair facility at "I" (General Support)].

g) TMFD [Modules through the module repair facility at "D" (Depot)].

For the selected policy GP, only TUFOC, TUFI, TUFD, and TMFD apply. From the definitions of these mnemonics, the need for all of these flows is obvious, except for TUFD. The selected policy (GP = 1.0) would normally have no LRU flow at the depot facility, unless:

FUI is less than 1.0.

SUO is less than 1.0.

SUI is less than 1.0.

There will be some units neither scrapped (1.-SUO = SUOC; 1.-SUI = SUIC) nor repaired (1.-FUI = FUIC), resulting in some overflow of LRUs needing repair and flowing from the forward support to the Depot levels.

TUFOC sees demand for all LRUs. The failed, the false no-go's, and the replacements for the attrited LRUs must be run through the checkout facility (Figure 15) as follows:

$\underline{\text{TUFOC} = 1.1114 \times 10^{-3}}$

TUFI results from the total flow through the Direct Support facility. False no-go's are weeded out of the flow by the Direct Support checkout effort. The attrited (or more exactly the replacements for the attrited LRUs) are returned to the forward location along with the false no-go's leaving only failed LRUs that are not to be scrapped [F*(1.-SUO) = F*SUOC = FCOC = $\underline{9.99 \times 10^{-4} = \text{TUFI}}$].

At the General Support level with GP = 1.0, the flow from the Direct Support level (FCOC) is repaired to the extent that the FUI value will permit. Those LRUs not repaired at GS [FCOC*(1-FUI)] are examined

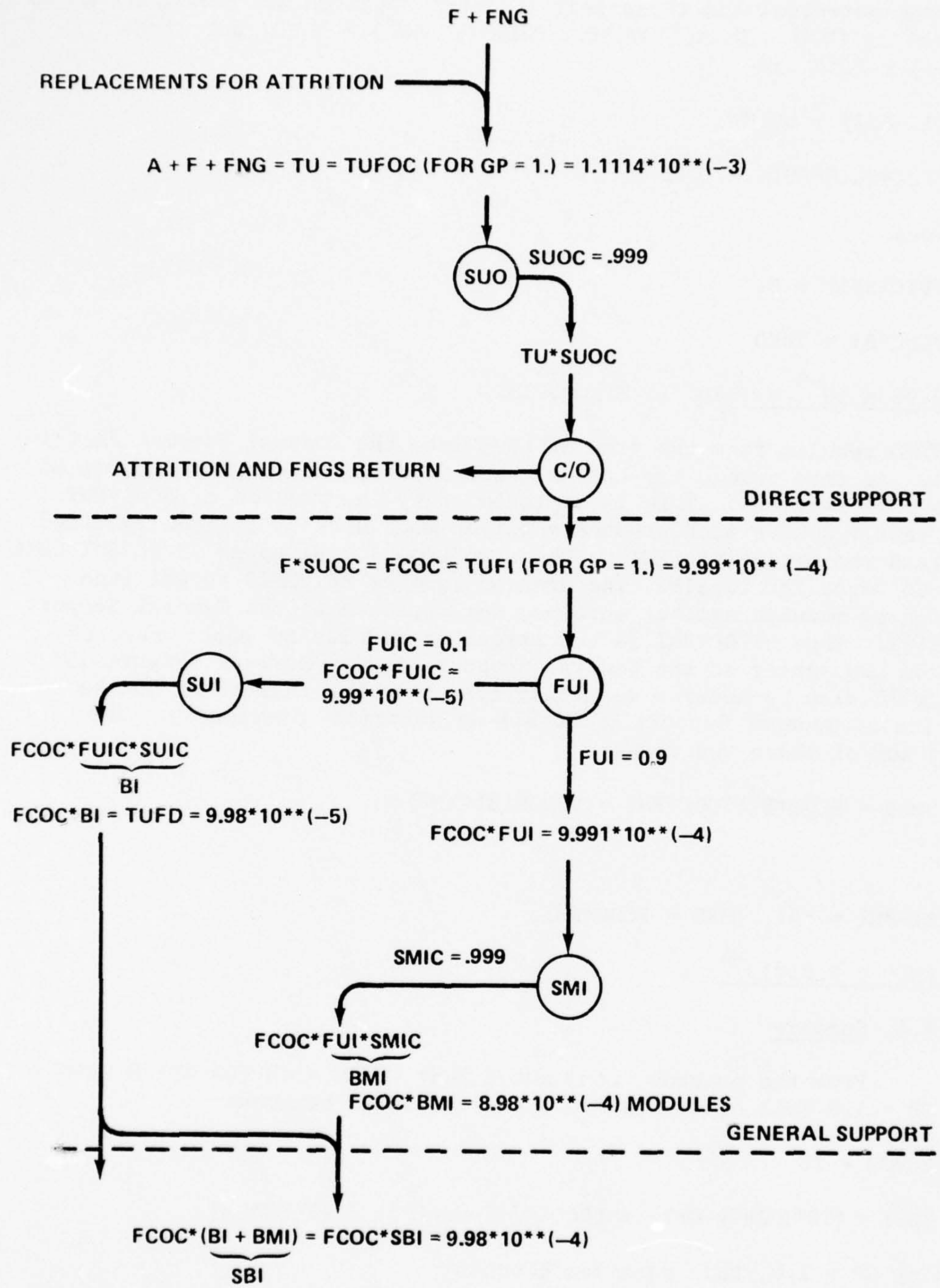


Figure 15. Demand for service with GP=1.

for scrap potential and those left (neither repaired nor scrapped) go on to Depot as TUFD. Thus, FCOC*(1.-FUI)*(1.-SUI) = TUFD; but since (1.-FUI) = FUIC and

(1.-SUI) = SUIC

FCOC*FUIC*SUIC = TUFD

and since

FUIC*SUIC = BI

FCOC*BI = TUFD

$\underline{9.98 \times 10^{-5} = \text{TUFD}}$ in Figure 15.

TMFD results from the flow of LRUs into the General Support facility (FCOC). At that point, the LRUs are repaired (to the degree determined by the FUI fraction). This is represented by the product of FCOC*FUI. These repaired LRUs each produce a failed module which is then examined for its scrap potential (SMI). These modules not scrapped (FCOC*FUI*SMIC) go on to Depot for repair. The program equates FUI*SMIC to BMI (the fraction of modules neither scrapped nor repaired at the General Support facility). Thus, FCOC*BMI is the stream of modules to Depot resulting from LRU repair at the General Support level. However (Figure 15) there will also be modules resulting from the LRUs that could not be reparied at General Support (FCOC*BI) as described previously. TMFD is the sum of these two flows:

TMFD = FCOC*BI+FCOC*BMI = FCOC*(BI+BMI)

since

BI+BMI = SBI, TMFD = FCOC*SBI

$\underline{\text{TMFD} = 9.98*10^{-4}}$.

4.4 Summary

From the program, it is noted that TUFOC = TU*(GB+GF+GH+GO+GP+GQ). With GP = 1.0 (all other G's = 0). this equation becomes:

TUFOC = TU

TUFI = (TU*(GE+GR+GS)) + (FCOC*(GF+GO+GP)) + (F*BO*GM) .

Allowing GP = 1.0, this equation becomes:

TUFI = FCOC

TUFD = (TI*(GG+GT)) + (FCOC*(GH+GQ+(BI*GP)))

+ (F*((BO*GN) + (BI*GS))) .

Allowing GP = 1.0, this equation becomes:

TUFD = FCOC * BI

TMFD = (F*((GN*SBO) + (GS*SBI) + GT)) + (FCOC*((GP*SBI) + GQ)) .

Allowing GP = 1.0, this equation becomes TMFD = FCOC*SBI.

4.5 Module and Part Scrap Rate Computation

For the selected maintenance policy of GP = 1.0, there are

a) TSMI - Modules scrapped at I (General Support).

b) TSMD - Modules scrapped at D (Depot).

c) TSPD - Parts scrapped at D (Depot).

All of these are scrap rates, i.e., modules or parts scrapped per hour per LRU location.

As in Section 4.4, only the failed LRUs are considered because the false no-go's and the attrited LRUs pass through the Direct Support level only.

TSMI results from all of the failed LRUs (F) not scrapped at Direct Support (F*SUOC = FCOC) which produce modules to be repaired at General Support. They are scrapped at the rate of SMI (TSMI = FCOC*SMI). The program's equation of TSMI = (F*GE) + (FCOC*GF) + ((((GR+(GM*SBO))*F) + (GO*FCOC))*SIC) + (((GP*FCOC) + (GS*F))*SMI) becomes

TSMI = FCOC*SMI if GP = 1.0

$\underline{TSMI = 9.99 \times 10^{-4} * .001 = 9.99 \times 10^{-7}}$.

TSMD is every module returned to Depot that cannot be repaired at Depot. It is either scrapped (SMD) or not repaired (SMDC*FMDC). The program defines this combination SMD+SMDC*FMDC = SDC. The total of modules returning Depot was defined in Section 4.4 as the product FCOC*SBI. Therefore, the module scrapped at D is the product of these two elements so that:

TSMD = FCOC*SBI*SDC

$\underline{TSMD = 9.99 \times 10^{-4} * .999 * .1 = 9.98001 \times 10^{-5}}$.

It is noted that the preceding equation results when all policies except GP are equal to zero and GP = 1.0 in the program's equation as follows:

TSMD = (GG*F) + (GH*FCOC) + (SDC*((F*((GN*SBO) + (GS*SBI) + GT)) +

+ (FCOC*((GP*SBI) + GQ)))) .

TSPD results from every module and LRU returning to Depot which was determined to be the returning modules from the General Support LRU repair and the overflowing nonrepaired, nonscrapped LRUs coming in from the General Support per Section 4.4 (for GP = 1.0). Thus,

TSPD = FCOC*SBI

$\underline{\text{TSPD} = 9.99 \times 10^{-4} * .999 = 9.98001 \times 10^{-4}}$.

This may be derived from the program's equation by letting all policies (GA-GO, GQ-GT = 0.0 and GP = 1.0 in the following equation:

TSPD = (FCOC*((GP*SBI) + GQ)) + (F*((GS*SBI) + GT + (GN*SBO))) .

4.6 Maintenance Work Orders

Frequency of Maintenance Work Orders (MWOs) results from a product of FMWO and ZO or ZI. The two products are called TMWO and TMWI respectively, but since YMWO has been set at zero (Figure 14), both of these are zero for this specific example:

TMWO = FMWO*ZO

TMWO = 0

TMWI = FMWO*ZI

TMWI = 0.

4.7 LRU Repair Rates

LRU repair rates differ according to the deployment and the location of the repair facility. In the program, repair rates at "F" (DS) for a specific policy are designated as RO (POLICY NO.). Similarly:

RI(N) denotes LRU repair rate at "I" (GS) for policy No. "N"

RD(N) denotes LRU repair rate at D (Depot) for policy No. "N" .

For the selected policy (GP = 1.0 or policy 16), there are no repairs at the DS level, but the false no-go's are, in effect, repaired since they are detected. Therefore,

$RO(16) = FNG$

$RO(16) = 0.0001$.

Repair of the LRUs is expected to take place at the GS level and RI(16) = RI(6) = FCOC*BCI. Since BCI = SUIC*FUI (the fraction not scrapped at I(GS)) but repaired at I(GS)) and FCOC has been shown to be the flow rate into the GS LRU repair facility. Thus:

$RI(16) = FCOC*BCI$

$\underline{RI(16) = 8.98*10^{-4}}$.

Some LRU overflow can and does occur as previously noted and these are repaired at Depot.

FCOC*BI has already been shown to be the overflow units and BCD = SUDC*FUD the fraction of flow units not scrapped but repaired at Depot. Therefore:

$RD(16) = FCOC*BI * BCD$

$\underline{RD(16) = 8.973*10^{-5}}$.

As with all previous values, these are in terms of LRUs repaired/hour/LRU deployed.

4.8 Reprocurement

Hours to start procurement of LRUs, modules, and parts are designated as HF, HM, and HP, respectively and are generated by changing the inputs HPU, HPM, HPP (input as days) and FTU, FTM, FTP (input as weeks in Appendix B) to hours and adding the related results. Thus with 14 days hold time and 13 weeks factory time:

$HF = (24.*HPU) + (168.*FTU)$

$\underline{HF = (24.*14) + (168.*13) = 2520 \text{ hours}}$

$HM = (24.*HPM) + (168.*FTM)$

$\underline{HM = (24.*14) + (168.*13) = 2520 \text{ hours}}$

$HP = (24.*HPP) + (168.*FTP)$

$\underline{HP = (24.*14) + (168.*13) = 2520 \text{ hours}}$.

4.9 Use of Subroutine BASIC

Basic shipping cost rates and quantities tied up are computed by calling the BASIC subroutine which, in general, uses rate of flow of parts, modules, and LRUs through the pipes and multiplies them by one way shipping costs to find the rate of cost to ship replacements; by two way shipping costs to find rate of cost to ship repairables, and (in a second call on BASIC) by pipeline and delay times to find the quantities held up. Pipeline times for items repaired must include the repair time. Figure 16 shows how this progress for both shipping cost rates (i.e., dollars per pound, per hour, per LRU location) and quantities (LRUs, modules, parts tied up per hour per LRU location).

For example, in the first call on BASIC the program is looking for shipping cost rates and provides the arguments (and values) shown in the chart to the left of the figure. Then the module repair float equation is:

```
QFMI = F*(((SMOC*FUO*GN*BBMD*ASLI)/DAOQL)

       + SMIC*((GM*BO*FMI*GMOD)

       +(SUOC*((GO*FMI*GMOD) + ((GP*FUI*BBMD*ASLI/DAOQL)))

       + (GR*FMI**GMOD) + ((GS*FUI*BBMD*ASLI)/DAOQL))))  .
```

For GP = 1.0 this reduces to:

```
QFMI = F*(0. + (SMIC*((0.) + (SUOC*((0.) + ((FUI*BBMD*ASLI)/DAOQL)))

       + (0.) + ((0.)/DAOQL))))

QFMI = F*SMIC*SUOC*(FUO*BBMD*ASLI)/DAOQL  .
```

In this equation (and most of the other equations) of the BASIC subroutine, most of the variables are brought in (or out) through the COMMON/BAS/list. This equation may be viewed as QFMI = ((F*SUOC*FUO*SMIC*BBMD)/DAOQL)*ASLI.

The portion enclosed in parentheses may be viewed as the flow of modules that are removed at the GS level and repaired at Depot. Because Depot is inefficient to the extent that only DAOQL (fraction) of the output is good, the actual flow through Depot is Flow/DAOQL. If DAOQL = 0.95:

<u>QFMI = ((.001*.999*.9*.999*.8991)/.95)*ASLI</u>

<u>QFMI = 8.5 x 10^{-4}*ASLI</u> .

ASL1 – BASIC	FIXM	FIXP	FIXU	BHF	BHM	BHP	REQD	DALR	GALR	DEPMOD	GMOD	DMOD	TRCE	ASLE	ASLO	ASL1
SHIPPING NAME	CDFD	CDFD	CDFD	DCFD	DCFD	DCFD	0.	CDIO	CDDI	0.	0.	0.	0.	SHETO	SHTOI	SHTID
VALUE	.05	.05	.05	.05	.05	.05	0.	.05	.05	0.	0.	0.	0.	.10	.10	.10
"DOWN" QUANTY NAME	168. *FTM	168. *FTP	168. *FTU	HF	HM	HP	24.* RDD	ROIT	RIDT	TUMD	TUMI	TUMO	TRC	TEOT	TEOT	TIDT
VALUE	2184	2184	2184	2520	2520	2520	24	148	148	100	100	100	1	148	148	

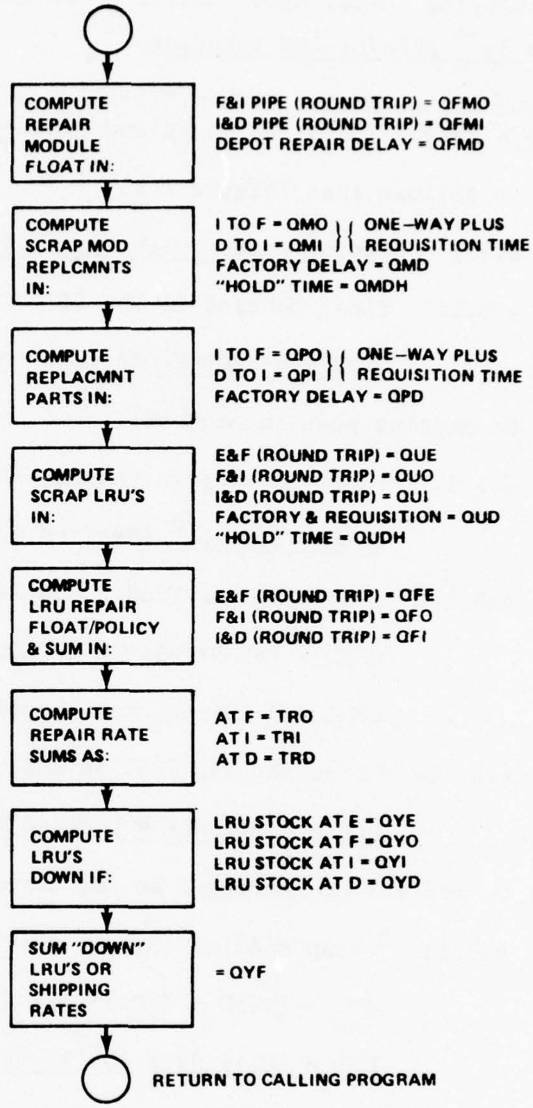


Figure 16. BASIC subroutine computes shipping cost rates and LRU quantity "Down."

For shipping costs, ASLI = SHTID = CDID+CDDI = .05+.05 = .10 and <u>QFMI = 8.5×10^{-4} $/lb/hr/LRU location</u>.

For quantities ASLI = TIDT = TID+TDI = 1+1 days + 100 (hours repair time) = 2*24 + 100 = 148 hours and <u>QFMI = 0.1258 modules/LRU</u> location.

It follows that (Figure 16):

4.9.1 <u>Shipping Costs (with GP = 1.0)</u>:

4.9.1.1 Float Modules in the DS - GS Pipe:

<u>QFMO = F*SMOD*FUO*ASLO*O. = 0</u>

No modules pass through DS

4.9.1.2 Float Modules in the GS - Depot Pipe:

<u>QFMI = $8.5*10^{-5}$</u> (Section 4.9)

4.9.1.3 Float Modules Tied Up in Depot Repair:

QFMI = (BBMD*F*BI*SUOC/DAOQL)*DEPMOD

QFMD = 0 (Since, for shipping, DEPMOD = 0)

4.9.1.4 Scrap Modules (DS) in the Replacement Cycle:

<u>QMO = TSMI*DALR = 0.*0.05 = 0</u>

No modules are scrapped at DS, hence TSMO = 0.

4.9.1.5 Scrap Modules (GS) in the Replacement Cycle:

QMI = (TSMO + TSMI)*GALR (Shipped Depot to GS)

<u>QMI = $(0.+9.99 \times 10^{-7})*.05 = 4.995 \times 10^{-8}$</u>

4.9.1.6 Scrap Modules (Depot) in the Replacement Cycle:

QMD = (TSMO+TSMI+TSMD)*FIXM (Shipped factory to Depot)

<u>QMD = $(0+9.99 \times 10^{-7}+9.98001 \times 10^{-5})*.05 = 5.04 \times 10^{-6}$</u>

4.9.1.7 Holding Time Multiplier:

AHPM = BHM-FIXM = 0.05 - 0.05 = 0

No shipping costs incurred for waiting.

4.9.1.8 Scrap Modules in "Holding Time" Shipping Costs:

$$\underline{QMDH = (TSMI+TSMI+TSMD)*AHPM = 0.}$$

Scrap modules are tied up but not shipped.

4.9.1.9 Parts Scrapped (DS) in the Replacement Cycle:

$$QPO - TSPO*DALR$$

$$\underline{QPO = 0.*0.05 = 0.}$$

No parts are scrapped at F (DS).

4.9.1.10 Parts Scrapped (GS) in the Replacement Cycle:

$$QPI = (TSPO+TSPI)*GALR$$

$$\underline{QPI = (0.+0.)*0.05 = 0}$$

No parts are scrapped at either DS or GS.

4.9.1.11 Parts Scrapped (Depot) in the Replacement Cycle:

$$QPD = (TSPO+TSPI+TSPD)*FIXP$$

$$\underline{QPD = (0.+0.+9.98 \times 10^{-4})*.05 = 4.99 \times 10^{-5}}$$

Replacement parts are shipped to Depot.

4.9.1.12 Holding Time (Parts) Multiplier:

$$AHPP = BHP-FIXP = .05-.05 = 0$$

There will be no charge for shipping parts tied up in waiting.

4.9.1.13 Parts tied up in the holding time:

$$QPDH = (TSPO+TSPI+TSPD)*AHPP$$

$$QPDH = (9.98001*10^{-4})*0. = 0 \quad \text{(Section 4.9.1.12)}$$

4.9.1.14 LRUs Scrapped at "E":

$$QUE = TSU*ASLE$$

$$\underline{QUE = 2.347*10^{-5}*.1 = 2.347*10^{-4}}$$

LRUs are scrapped at F (DS) (not E) and replacements are shipped back to E, hence the round trip (ASLE = SHTEO = CDEO+CDOE = .05+.05 =.0) cost.

4.9.1.15 LRUs Scrapped at DS:

QUO = TSU&ASLO

$\underline{QUO = 2.347*10^{-5}*.1 = 2.347*10^{-6}}$

Scrapped LRUs and their replacements shipped between F (DS) and I (GS).

4.9.1.16 LRUs Scrapped at GS:

QUI = TSU*ASLI

$\underline{QUI = 2.347 \times 10^{-5}*0.1 = 2.347 \times 10^{-6}}$

Scrap LRUs are shipped and their replacements between I (GS) and D (Depot).

4.9.1.17 LRUs Scrapped at Depot:

QUD = TSU*(FIXU+REQD)

$\underline{QUD = 2.347 \times 10^{-5}*(0.05+0.) = 1.173443 \times 10^{-6}}$

These are replacements for scrapped LRUs from factory to Depot.

4.9.1.18 LRUs Tied Up in the "Holding" Time:

QUDH = TSY(BHF-FI)

$\underline{QUDH = 2.347 \times 10^{-5}*(0.05-0.05) = 0}$

There is no charge for shipping LRUs tied up in the time of collecting orders for replacements.

4.9.1.19 "Float" LRUs in the E - DS Pipe:

QE(16) = (RO(16)+RI(16)+RD(16))*ASLE

$QE(16) = (0.0001+8.98 \times 10^{-4}+8.973 \times 10^{-5})*.1$

$\underline{QE(16) = (1.088 \times 10^{-3})*0.1 = 1.088 \times 10^{-4}}$

This is the cost to ship all repaired LRUs between E (equipment) and F (DS).

4.9.1.20 "Float" LRUs in the DS-GS Pipe:

QO(16) = (RI(16)+RD(16)*ASLO

$$QO(16) = (8.98 \times 10^{-4} + 8.973 \times 10^{-5})*.1$$

$$\underline{QO(16) = (9.8773 \times 10^{-4})*.1 = 9.8773 \times 10^{-5}}$$

Repaired LRUs are shipped between F (DS) and I (GS).

4.9.1.21 "Float" LRUs in the GS - Depot Pipe:

$$QI(16) = (KD(16))*ASLI$$

$$\underline{QI(16) = (8.973 \times 10^{-5})*.1 = 8.973 \times 10^{-6}}$$

Repaired LRUs are shipped between I (GS) and Depot.

4.9.1.22 Summarization of E "Float" LRUs:

$$\underline{QFE = QE = 1.08793 \times 10^{-4}}$$

There is only one maintenance policy so QFE and QE are identical; QFE is a summary of all QEs.

4.9.1.23 Summarization of DS "Float" LRUs:

$$\underline{QFO = QO = 9.8773 \times 10^{-5}} \quad \text{(Section 4.9.1.22)}$$

QFO is a summary of all QOs.

4.9.1.24 Summarization of GS "Float" LRUs:

$$QFI = 8.973 \times 10^{-6} \quad \text{(Section 4.9.1.22)}$$

QFI is a summary of all QIs.

4.9.1.25 Summarization of DS Repair Flow:

$$TRO = RO(I)+TRO+(\Sigma RO(I)) = RO(16)$$

$$\underline{TRO = .001}$$

This is a summary of all repair flow through F (DS).

4.9.1.26 Summarization of GS Repair Flow:

$$\underline{TRI = \Sigma RI(I) = RI(16) = 8.98 \times 10^{-4}}$$

This is a summary of all I (GS) repair flow.

4.9.1.27 Summarization of Depot Repair Flow:

$$\underline{TRD = \Sigma\ RD(I) = RD(16) = 8.973 \times 10^{-5}}$$

This is a summary of all D (Depot) repair flow.

4.9.1.28 Depot Repair Flow Adjusted:

$$\underline{TRD = 8.973 \times 10^{-5}/.95 = 9.9445 \times 10^{-5}}$$

4.9.1.29 GS "Float" Adjusted:

QFI increased because of ineffective Depot repair.

$$QFI = QFI/DAOQL$$

$$\underline{QFI = 8.973 \times 10^{-6}/.95 = 9.445 \times 10^{-6}}$$

4.9.1.30 LRUs Shipped E to E (Lru Stock at E):

$$\underline{QYE = TU*0.}$$

QYE = 0. (no shipping cost)

4.9.1.31 LRUs Shipped Through the E-F-E Pipe (With LRU Stock at DS):

$$QYO = TY*(TRCE + ASLE)$$

$$\underline{QYO = 1.1114 = 10^{-3}*(0+.10) = 1.1114 = 10^{-4}}$$

Cost to ship through the E-F-E pipe.

4.9.1.32 All LRUs Between E and GS:

$$QYI = QYO + QUO + QFO = 1.1114 = 10^{-4} + 2.347 \times 10^{-6}$$
$$+ 9.8773 \times 10^{-5}$$

$$\underline{QYI = 2.1226 * 10^{-4}}$$

This is a summary of the costs to ship all LRUs to and from the F (DS) checkout point (the scrapped LRUs and their replacements between DS and GS and the repaired LRUs between DS and GS).

4.9.1.33 All LRUs Between E and Depot:

QYD = QYI + QUI + QFI adds to the costs of 4.9.1.32 the cost to ship the (overflow) repaired LRUs and the scrapped LRUs between I (GS) and D (Depot).

$QYD = 2.1226 * 10^{-4} + 2.347 \times 10^{-6} + 8.973 + 10^{-6} = 2.2358 * 10^{-4}$

4.9.1.34 Total LRU Shipping Costs (Adds to 4.9.1.33 the Cost to Ship Replacements From Factory to Depot):

$$QYF = QYD + QUD$$

$$QYF = 2.2358 = 10^{-4} + 1.173443 \times 10^{-6} = 2.2475 \times 10^{-4}$$

4.9.2 Saving Shipping Factors:

4.9.2.1 LRUs

$$SHU = QYF = (FMWO * (SHTEO + ((1.-ZO) * SHTOI)$$
$$+ ((1.-ZO-ZI) * (SHTID/DAOQL))))$$

$$SHU = 2.2475 \times 10^{-4} + (0.) = 2.2475 \times 10^{-4}$$

This is the total LRU shipping factor saves as SHU.

4.9.2.2 Modules:

$$SHM = QMO + QMI + QMD + QFMO + QFMI + QFMD$$

$$SHM = 0. + 4.995 \times 10^{-8} + 5.04 \times 10^{-6} + 8.5 \times 10^{-5} + 0$$

$SHM = 9.009 \times 10^{-5}$ \$/hr/lb/LRU Location

4.9.2.3 Parts:

$$SHP = QPO + QPI + QPD$$

$SHP = 0. + 0. + 4.99 \times 10^{-5} = 4.99 \times 10^{-5}$ \$/hr/lb/LRU Location

4.9.3 BASIC Computed Supply Quantities (With GP = 1.0):

All of the equations of 4.9.1 are invoked again, but with time multipliers instead of cost multipliers. Thus:

4.9.3.1 Float Modules in DS - GS Pipe:

$$QFMO = F * SMOC * O$$

QFMO = 0. modules/per LRU location are in the repair pipe between F (Direct) and I (General).

4.9.3.2 Float Modules in GS - Depot Pipe:

$QFMI = 8.5 \times 10^{-4} * 148$ (Section 4.9)

$\underline{QFMI = .1258}$ modules in the repair pipe between General and Depot per LRU location.

4.9.3.3 Float Modules at Depot:

QFMD = (BBMD * F * BI * SUOC/DAOQL) * DEPMOD

QFMD = (.8991 * .001 * 0.999/.95) * 100.

$\underline{QFMD = 9.445 \times 10^{-3}}$ modules tied up in Depot repair time.

Referring to Figure 15, these are the modules that arrive at Depot in unrepaired LRUs via the SUI valve (TUFD). The modules from the GS repaired LRUs (FCOC * BMI) are the modules in the I-D-I pipe (QFMI) and must be stocked at GS. QFMD modules must be stocked at Depot for replacement of the Depot-replaced module. This is the reason the pipeline times must include the TUMO, TUMI, TUMD values (or, for LRUs, the LRU repair times).

4.9.3.4 Modules Scrapped at DS:

QMO = TSMO * DALR

Even though DALR now has a value for policy GP = 1, TSMO = 0 so QMO = 0. (There are no modules scrapped at Direct Support).

4.9.3.5 Modules Scrapped at GS Tied Up in the Resupply Cycle:

QMI = (TSMO + TSMI) * GALR

$\underline{QMI = (0. + 9.99 \times 10^{-7}) * 148. = 1.48 \times 10^{-4}}$

These are the modules that must be stocked at I (GS) to account for the replacement of scrapped modules.

4.9.3.6 Modules Scrapped at Depot Tied Up in the Resupply Cycle:

QMD = (TSMO + TSMI + TSMD) * FIXM

$\underline{QMD = (0. + 9.99 \times 10^{-7} + 9.9800 \times 10^{-4}) * 2184 = 2.18}$

These modules are those that must be stocked at Depot to overcome the long resupply time. Note that the scrap at Direct Support (F) (non-existent for this policy) and at General Support (I) is included in the stock. The module scrap stock at I is enough to stock the I-D-I pipeline only.

4.9.3.7 Holding Time for Modules:

AHPM = BHM-FIXM

AHPM = 2520-2184 = 336 hours

The holding time over which replacement orders are accrued.

4.9.3.8 Modules Tied Up in the Holding Time:

QMDH = (TSMO + TSMI + TSMD) * AHPM

$QMDH = (0. + 9.99 * 10^{-7} * 9.98001 * 10^{-4}) * 336.$

QMDH = .33566 modules must be stocked to account for the delay in placing orders.

4.9.3.9 Parts Scrapped at Direct Support:

QPO = TSPO * DALR = 0 because for policy GP = 1 no parts are scrapped at 0 (DS).

4.9.3.10 Parts Scrapped at General Support:

QPI = (TSPO + TSPI) * GALR

QPI = (0 + .0) * 148 = 0 since, for GP = 1 no parts are stocked forward of Depot.

4.9.3.11 Parts at Depot to Account for Replacement Cycle:

QPD = (TSPO + TSPI + TSPD) * FIXP

$QPD = (0. + 0. + 9.98001 \times 10^{-4}) * 2184$

QPD = 2.1796 parts stocked per LRU location at the Depot to account for scrap replacement time.

4.9.3.12 Parts Holding Time:

AHPP = BHP-FIXP

AHPP = 2520-2184 = 336 hours holding time during which orders are accumulated for replacement of parts.

4.9.3.13 Parts Tied Up in Holding Time:

QPDH = (TSPO + TSPI + TSPD) * AHPP

$QPDH = (0. + 0. + 9.98001 \times 10^{-4}) * 336.$

$\underline{QPDH = .3353}$ parts per LRU location to account for order accumulation.

4.9.3.14 Scrapped LRUs in The E-DS Pipe:

$QUE = TSU * ASLE$

$QUE - 2.347 * 10^{-5} * 148.$

$\underline{QUE = 3.47 * 10^{-3}}$ LRUs per LRU stocked at E to account for the round trip between E and GS for all LRUs (or "down" units in the E-O-E pipe due to scrap).

4.9.3.15 Scrapped LRUs in the Direct Support - General Support Pipe:

$QUO = TSU * ASLO$

$QUO = 2.347 * 10^{-5} * 148,$

$\underline{QUO = 3.47 * 10^{-3}}$ LRUs (per LRU) stocked at F (DS) account for the round trip to GS for repair (or "down" LRUs in the F-I-F pipe due to scrap.

4.9.3.16 Scrapped LRUs in the General Support - Depot Pipe:

$QUI = TSU * ASLI$

$QUI = 2.347 * 10^{-5} * 148.$

$\underline{QUI = 3.47 * 10^{-3}}$ LRUs (per LRU location) stocked at I (GS) account for LRU scrap and replacements in the I-D-I pipe (or "down" scrap units in that pipe due to scrap).

4.9.3.17 Scrapped LRUs in the Factory - Depot Pipe:

$QUD = TSU * (FIXU + REQD)$

$QUD = 2.347 * 10^{-5} * (2184. + 24.)$

$\underline{QUD = .05182 \text{ LRUs}}$ (per LRU location) stocked at Depot account for LRU scrap replacements in the holding and factory response time (FIXU) and the requisition process time (REQD).

4.9.3.18 Scrapped LRUs Tied Up in the Holding Time:

QUDH = TSU * (BHF-FIXU)

QUDH = $2.347 * 10^{-5}$ * (2520-2184)

QUDH = $7.886 * 10^{-3}$ LRUs (per LRU location) stocked at Depot account for the scrap accruing during the "holding" time of accumulating requisition.

4.9.3.19 Float LRUs in the E - Direct Support Pipe:

QE(16) = (RO(16) + RI(16) + RD(16) * ASLE

QE(16) = (.0001 + $8.98 * 10^{-4}$ + $8.973 * 10^{-5}$) * 148

QE(16) = .161 LRUs (per LRU location) stocked at E would account for the repair float in the E-O-E pipeline.

4.9.3.20 Float LRUs in the Direct Support - General Support Pipe:

QO(16) = (RI(16) + RD(16) * ASLO

QO(16) = ($8.98 * 10^{-4}$ + $8.973 * 10^{-5}$) * 148

QO(16) = .146 LRUs (per LRU location) stocked at F (Direct Support) would account for the LRU repair float in the F-I-F pipeline.

4.9.3.21 Float LRUs in the General Support - Depot Pipe:

QI(16) = (RD(16)) * ASLI

QI(16) = $8.973 * 10^{-5}$ * 148

QI(16) = .1328 LRUs (per LRU location) stocked at I (General Support) would account for the LRU repair float in the I-D-I pipeline.

4.9.3.22 Summarization of LRU Float (All Policies) for E:

QFE = QE = QE(16) = .161 (Since only one policy (GP = 1.) is being considered the sume of QE(1) through QE(20) is the same as QE(16).

4.9.3.23 Summarization of All Direct Support LRU Float (All Policies)

QFO = QO = QO(16) = .146 (for the same reason as 4.9.3.22)

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4.9.3.24 Summarization of All General Support LRU Float (All Policies)

$\underline{QFI = QI = QI(16) = .1328}$ (Section 4.9.3.22)

4.9.3.25 LRU Repair Flow Through Direct Support (All Policies)

$\underline{TRO = RO(16) = .0001}$ (Section 4.9.3.22)

4.9.3.26 LRU Repair Flow Through General Support (All Policies)

$\underline{TRI = RI(16) = 8.98 * 10^{-4}}$ (Section 4.9.3.22)

4.9.3.27 LRU Repair Flow Through Depot (All Policies)

$\underline{TRD = RD(16) = 8.973 * 10^{-5}}$ (Section 4.9.3.22)

4.9.3.28 Adjusted LRU Repair Flow Through Depot:

TRD = TRD/DAOQL

$\underline{TRD = 8.973 * 10^{-5}/.95 = 9.445 * 10^{-5}}$ (increase TRD because of Depot ineffectiveness)

4.9.3.29 Adjusted LRU Float (General Support):

QFI = QFI/DAOQL

$\underline{QFI = .01328/.95 = .01398}$ (increase due to Depot ineffectiveness)

4.9.3.30 LRUs "Down" if LRU Stock at E:

QYE = TU * TRCE

$QYE = 1.1114 * 10^{-3} * 1.$

$\underline{QYE = 1.1114 * 10^{-3}}$ LRUs (per LRU location) would be "down" in the process of replacing LRUs if stock is at E.

4.9.3.31 LRUs "Down" if LRU Stock at Direct Support:

QYO = TU * (TRCE * ASLE)

$QYO = 1.1114 * 10^{-3} * (1 * 148.)$

$\underline{QYO = .166}$ LRUs (per LRU location) would be "down" if the nearest stock pile were at 0 (Direct Support)

4.9.3.32 LRUs "Down" if LRU Stock at General Support:

QYI = QYO + QUO + QFO

$QYI = .166 + 3.47 * 10^{-3} + 0.146$

QYI = .31617 LRUs (per LRU location) would be "down" if LRU stock were kept at I (General Support)

4.9.3.33 LRUs "Down" if LRU Stock at Depot:

QYD = QYI + QUI + QFI

$QYD = .31617 + 3.47 * 10^{-3} + .01328$

QYD = .333 LRUs (per LRU location) would be "down" if LRU stock were kept at Depot.

4.9.3.34 LRUs "Down" if No LRUs are Stocked:

QYF = QYD + QUD

QYF = .333 + .05182

QYF = .38482 LRUs (per LRU location) would be "down" if no LRU stock is kept at all.

4.9.4 Adjust Calculation. Increase flow through repair facilities due to Depot inefficiency:

$TUFD = TUFD/.95 = 9.98001 * 10^{-5}/.95 = 1.05 * 10^{-4}$

$TMFD = TMFD/.95 = 9.98001 * 10^{-4}/.95 = 1.05 * 10^{-3}$

TMWD = FMWO * (1. - ZO-ZI)/DAOQL) = 0

4.10 Availability

This subject is discussed in greater detail in Section 6 and hence will be treated relatively lightly here.

The availability equation of the program is given in terms of operable LRUs relative to the total LRUs that could be operating. Since everything to date is on a per LRU basis, this is really the fraction of LRUs (out of a single LRU) that is operable.

First, the quantity of LRUs down is:

QYZ = QYE * H(1) + (QYO * H(2) * (1.-H(1))) + QYI * H(3) *

(1. -H(1)) * (1. -H(2))) + (QYD * H(4) * (1. -H(1)) *

(1. -H(2)) * (1. -H(3))) + (1. - H(1)) * (1. -H(2)) *

(1 - H(3)) * (1 -H(4)) * QYF

This equation, using the results of the second call on BASIC, yields the total fraction of an LRU that may be "down" at any instant. If, H(2) through H(4) = 1. then in terms of the preceding equation for QYZ:

QYZ = 0. + .1667 + 0. + 0. + 0. = .1667

Availability = EE/(EE + OTF * QYZ) if, as stated previously, EE = 1. and if OTF = .8

AYZ = 1./(1 + .8 * 0.1667) = .8823

4.11 Adjustment of Values

As explained in Section 6.2, availability and supply are interactive because failed items decrease flow.

With the first computation of availability, AYZ = EE/(EE + OTF * QYZ). This is modified by the SPOL function (which increases availability in response to built-in spares (FN of Appendix B) per the equation: AYZIS = SPOL (AYZ, FN, EE). The system availability (to date) is computed and stored as CAYZ(I) in which (I) may have a value of 1 through 10 as specified by TAYZ(I).

At this point, the multipliers which reflect the quantity of units (SAVE), of each module type (SAVP) and of each part type (SAVPP) are modified per the availability currently in effect (AYZ).

The demand quantities QUE, etc., computed in Section 4.9 are adjusted to reflect the inherent availability by multiplying them by the SAVE described previously and the actual number of items to be stocked are calculated per section 6.2, adjusted per the Back Order Quantity of Section 6.3 and the availability is readjusted to represent operational availability (AYZOS).

System availabilities (CAYZ(1)) are then readjusted using AYZOS and the following multipliers are re-defined as follows:

a) SAVE (LRUs on line and operating).

b) SAVP # each module type on line and operating.

c) SAVPP # each part type on line and operating.

d) SAVEOB # LRUs per Direct Support.

e) SAVEIB # LRUs per General Support.

f) SAVEDB # LRUs per Depot.

These new multipliers reflect the new availability and are used to adjust quantities of LRUs, modules and parts stocked, consumed and/or purchased. They also affect the flow and hence the workload on personnel and test equipment.

The costs of Section 6.1 are based on these modified flows and quantities.

SECTION 5
MAINTENANCE POLICY SELECTION

The logistic and maintenance support system possibilities which may be considered comprise sixteen basic maintenance policies with four possible levels of inventory support for each; this leads to 192 possibilities. The 16 basic maintenance policies are summarized in Figure 17. LOCAM additionally allows the analyst to split maintenance policy and stock location - this leads to a number of combinations which are essentially unlimited.

5.1 Policy "G" Factors

The LOCAM deployment matrix shows four possible levels of maintenance support: at the Equipment proper, at a Direct Support level, at a General Support level, and at a Depot level. The model additionally assumes that faults are identified in accordance with the LRU removal rate E at the equipment level. LOCAM also provides three levels of maintenance support capability: unit checkout (COU), fault isolation of the unit to a faulty module (FIM), and module test and repair (FIP). It provides three levels of logistic discard: unit, module, and part.

The maintenance levels at which work is performed and the test equipment, test, and repair manpower locations are specified by "G" factors. These are the same "G" terms illustrated on Figure 17. The same factors are used to define the flow of maintenance work in the postulated system or given deployment. These input factors GA through GT must total unity so that all work is accounted for. These factors are:

GA = Specifies the unit (LRU) discard policy, - i.e., there is no maintenance activity.

GB = Specifies LRU discard with test capability to identify false No-Go.

GD = LRU repair at a Direct Support facility by module replacement and discard.

GE = LRU repair at a General Support facility by module replacement and discard.

GF = LRU repair at a General Support facility with false No-Go identification at Direct Support.

GG = LRU repair at Depot by module replacement and discard.

GH = LRU repair at Depot by module replacement and discard.

GH = LRU repair at Depot with false No-Go identification at Direct Support.

GL = LRU and module repair at Direct Support facility.

FOR THE MAINTENANCE POLICY DESIGNATED BY

TEST EQUIPMENT WILL BE LOCATED AT	GA	GB	GD	GE	GF	GG	GH	GL	GM	GN	GO	GP	GQ	GR	GS	GT	TEST EQUIPMENT CAN ISOLATE FAULTS TO THIS LEVEL
EQUIPMENT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UNIT
DIRECT SUPPORT		X	X		X		X	X	X	X	X	X	X				UNIT
			X					X	X	X							MODULE
								X									PART
GENERAL SUPPORT				X	X				X		X	X		X	X		UNIT
				X	X				X		X	X		X	X		MODULE
									X		X			X			PART
DEPOT						X	X			X		X	X		X	X	UNIT
						X	X			X		X	X		X	X	MODULE
										X		X	X		X	X	PART
REPAIR WILL BE ACCOMPLISHED BY DISCARDING AND REPLACING THE FAILED.	UNIT	UNIT	MODULE	MODULE	MODULE	MODULE	MODULE	PART	PART	PART	PART	PART	PART	PART	PART	PART	

Figure 17. Maintenance policy matrix.

GM = LRU repair at a Direct Support facility, module and overflow LRU repair at the General Support level.

GN = LRU repair at a Direct Support facility, module and overflow LRU repair at Depot.

GO = LRU checkout at a Direct Support facility, LRU and module repair at the General Support level.

GP = LRU checkout at a Direct Support facility, LRU repair at the General Support level, module and overflow LRU repair at Depot.

GQ = LRU checkout at a Direct Support facility, unit and module repair at Depot.

GR = LRU and module repair at a General Support facility.

GS = LRU repair at a General Support facility, module and overflow LRU repair at Depot.

GT = LRU and module repair at Depot.

(GC, GI, GJ and GK are not used.)

The matrix of the "G" factors as structured to form the maintenance policies that are built into the LOCAM formulation is shown in Figure 17. This matrix identifies the support posture options available within the LOCAM 5 model. These alternatives are designated GA through GT in the upper part of the matrix. Sixteen alternatives are available and as discussed previously, they can be combined so that a percentage of work is accomplished by one policy with the balance being accommodated by other policies selected from the matrix. In the matrix, X indicates that the options listed around the perimeter of the chart apply for the block in which the X is located. A blank in a block indicates that there is no applicable action taking place.

For example, the X in the third column from the left in the third row from the top is to be interpreted in the following way:

(Start at the left-hand edge of the chart)

For the maintenance policy designated "GD," test equipment will be located at DIRECT SUPPORT. Test equipment at Direct Support can isolate faults to the level of the failed MODULE. Repair will be accomplished by discarding and replacing the failed MODULE.

By designating percentages of the work flow through values of the inputs GA through GT, work is assigned to Direct Support, General Support, and Depot and provides for overflow of UNIT/LRU repair to the next higher level as required. Scrap fractions, a portion of the work flow deemed not repairable, can be assigned to UNIT/LRU and modules at each maintenance level. Scrapped items are part of the cumulative material requirements for resupply stocks from higher levels.

5.2 Maintenance Policy Example

LOCAM Maintenance Policy No. GP with unit stock located at the Direct Support level is shown in Figure 18. Maintenance Policy GP places an LRU checkout capability at the Equipment and Direct Support levels, a fault isolate to module at the General Support level and a module repair facility at the Depot level. All policies have ultimate recourse to a reorder cycle.

In Policy GP, failed units are sent from Equipment to Direct Support. LRUs which test well at Direct Support - False Report of Failure - are returned to Equipment. Those which also fail at Direct Support are replaced with an LRU from stock and sent on to General Support.

At the General Support level, those LRUs successfully fault isolated to the module are repaired by module replacement and returned to LRU stock at Direct Support. The failed modules detected at General Support and any LRUs still not fault isolated are sent on to Depot.

Failed modules are repaired at Depot and any LRUs repaired at Depot are returned to stock at Direct Support. The black lines which flow upward in the center of the diagram represent the flow of failed LRUs from Equipment level through Direct Support and General Support to Depot. The dotted line from Direct Support back to Equipment represents the return of False Report of failure LRUs.

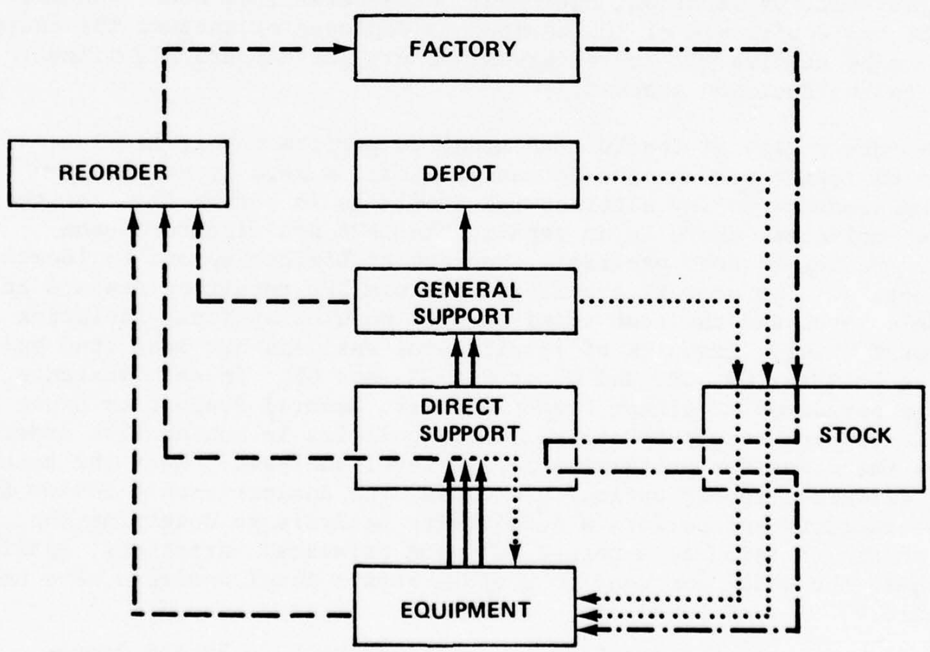

Figure 18. LOCAM 5 maintenance policy GP.

The dotted lines from General Support and Depot to Direct Support stock represent the return of repaired LRUs to stock. The dashed lines represent an LRU reorder cycle which is satisfied by new LRUs from the factory which follow the combined dot-dash lines. The latter route from Direct Support stock to Direct Support and back represents a checkout of new LRUs before they are put into stock.

Figure 18 shows the pipelines associated with the flow of failed, repaired, and replacement LRUs. There are other (and separate) pipelines for modules and parts which are not shown. Modules and parts are stocked "where used," in this case spare modules are stocked at General Support and Depot and spare parts are stocked at Depot.

The formulation also provides for a percentage (a program input) of LRUs and modules to be scrapped in maintenance activity at each level where they are subject to maintenance test and/or repair.

5.3 Repair Versus Discard and Optimum Repair Level Analysis ORLA

In defining the detailed maintenance concept and establishing criteria for equipment design, it is sometimes necessary to determine whether items should be repaired in the field (Direct Support or General Support), repaired at the Depot/Supplier facility, or discarded in the event of failure. As with other types of logistics cost analysis, the first step is to define the operational requirements in terms of equipment deployment, utilization, equipment characteristics, etc. Whether there are two equipments or 100 equipments deployed or whether the equipment is to be utilized 12 hours versus 4 hours per day are significant factors in the decision process.

The versatility of the LOCAM 5 model to perform repair level analysis or repair versus discard analysis can be seen by examination of the maintenance policy alternatives available in Figure 17. For the first two policies, there is no repair; the LRUs are discarded upon failure. Policy GB does provide a checkout at Direct Support to locate false no-go's. The next five policies perform LRU repair by discard at the module level and the rest repair faulty modules by fault isolating to the part level. Examples of repair level analysis are indicated by comparing policies GD, GE, and GG or GL, GR, and GT. In each instance, repair is performed at either Direct Support, General Support or Depot and an input deck structured to run these policies in consecutive order provides the means for performing repair level analysis. When the results for the different repair options are close, the analyst should review the data for validity and perform a sensitivity analysis to determine the impact on the decision as a result of input parameter variations. Applications where the model was used to perform repair level analysis have been documented.*

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*Life Cycle Logistic Support Cost Study, Supplement to System Design Trade Study Report, Design to Unit Production Cost, US Army Tank Automotive Command, Warren, Michigan, 8 June 1976, Contract No. DAAE 07-76-C-0068.

5.4 Repair of LRUs and Modules

Cost of the LRUs and modules may be developed in LOCAM 5 by computing manpower, test equipment, and material costs or can be modeled simply as so many dollars per repair. This might be representative of repair at a contractor facility where the Depot level is used as that facility. To model as dollars per repair the following inputs must be made:

CDPRMN = 8766	Number of hours per year on which costs are based.
TDPMI = 0 TDPMII = 0	Deletes productivity factor for test equipment manpower.
TDPRI = 1 TDPRII = 1	Eliminates productivity factor for repair manpower.
TDR = (Dollars per repair of LRU) TMDR = (Dollars per repair of module)	Creates terms where cost of repair manpower is really cost of repair.
FNSP = 0	Deletes parts cost. Presumably absorbed in TDR and TMDR.
FUD = 1 FMD = 1	Will repair all items and create no demand for reprocurement of LRUs and modules. Reprocurement is presumably absorbed in TDR and TMDR.
TD = 0 TMD = 0	Deletes all cost for LRU and module test manpower at the depot.
EVDT = 1 EVDM = 1 EVDR = 1	Necessary to assure expected value charged per TDR and TMDR.
WDR = 168 WDM = 168 WD = 168	Necessary to maintain work week in order to not change constant 8766.
ARA = 0	Deletes manpower retraining cost.
TMDD = 0	Deletes manpower for installing MWO kits at Depot.
SUD = 0 SMD = 0	Creates no demand for reprocurement of scrapped LRUs and modules. All items arriving at Depot will presumably be repaired.

SECTION 6
LOCAM THEORY

This section deals with the theory and methods of computing costs, supply and availability. These topics have been discussed to some extent in Section 3, to a greater extent in Section 4, but are examined in detail here.

Costs, in LOCAM 5, are based in general on the analyst's basic input cost per item, hour, pound, etc. and the degree to which LOCAM 5 determines the need for such item. For example, the analyst may input the cost of an LRU (CUP). The program, from other inputs, may compute the number of LRUs deployed and multiply by CUP to determine the total cost of the deployed LRUs. More typically, LOCAM 5 determines how many LRUs (of this type) fail, require repair at a particular location and/or all possible locations, determines the personnel hours needed to perform such repair and multiplies this figure by the analyst's cost per unit of personnel time to compute this aspect of cost. Such costs may be based on expected values or on integer quantities of people and/or equipment at each location.

The principal yardstick, scale or standard by which LOCAM evaluates the performance of the system being examined is cost. Bear in mind that the term "system being examined" has a broad meaning. In the context of LOCAM 5 "the system being examined" includes the following:

a) The prime equipment.

b) The support equipment.

c) The support concept.

d) The supply system.

Consequently, the aspects of costs to be considered must include:

a) Prime equipment:

   1) Costs to develop the prime equipment.

   2) Effect of that portion of costs considered to be "sunk" costs.

   3) Salvage value of the prime equipment.

   4) Costs of the deployed prime equipment.

b) Cost of test equipment:

   1) Cost of developing test equipment.

2) Cost to acquire test equipment.
3) Cost of test equipment manpower.
4) Cost of test equipment support.
5) Cost of test equipment software.
6) Salvage value of test equipment.

c) Cost of facilities: Cost of space used by test equipment and repair facility.

d) Manpower:

1) Cost of contact support manpower.
2) Cost to train test equipment people.
3) Cost to train repair people.
4) Cost of test equipment and repair labor.

e) Supply:

1) Inventory cost.
2) Cost of material consumed.
3) Salvage value of consumed material.
4) Salvage value of residual material.
5) Cost of supply.
6) Cost to reorder.
7) Storage costs.
8) Cost to enter and maintain elements in the supply system.
9) Supply administration.
10) Shipping and handling costs.
11) Cost of money (and its effect on schedule and costs).

Most of the preceding costs are interactive with the effectiveness of the support system. For example, the amount of manpower required to repair an LRU depends upon how long it takes to repair it and how soon the LRU fails again after it is put back in service. The sooner the LRU is put back into service, the sooner it will fail and more time is spent in making repairs. To understand this, the following two extremes are considered:

a) Case 1: There are no spare units. When the LRU fails, the system must wait until the failed unit is repaired before a unit may be placed back in service.

b) Case 2: There is an unlimited supply of spare units. When one unit fails, a substitute unit may be placed in service immediately (no lost time).

In Case 1, it is obvious that the system can never benefit from having more than one repair location because there is only one unit to be be worked on at any time.

In Case 2, depending on how soon each unit fails and how long the repair operation takes, many repair facilities may be required (if repair is to be performed) just to keep the repair station from being buried under the LRUs awaiting repair.

It is equally obvious that in Case 2 there will always be a unit available for use (equipment availability is 100% in this case). In Case 1, however, the unit is not available for use much of the time. If the unit were operational for only one hour out of every four (if it worked for one hour but required three hours to replace or repair it), the system would have an availability of 25% (one fourth of the time). Of course, no more failures are going to occur during the three hours the unit is in the repair or replacement process. Thus, those costs are affected by the rate of failures are affected by the availability because the greater the availability, the greater the flow of work through the repair facility and the greater the demand for replacements. Conversely, the better the support, the higher the availability.

Availability of the prime equipment thus affects the quantity of spares required (and manpower) and the availability of the spares affects the availability of the equipment.

It is in this interaction of support effectiveness and support costs that LOCAM becomes involved in the feedback of availability and costs.

6.1 Theory of Costs

All cost computations are developed individually for each LRU type. (Figure 19 contains the key of these costs to the output.

6.1.1 Prime Equipment Cost (I of Figure 19). This cost is represented by the mnemonic CET (or later by VV(3)),

VV(3) = CET = CED + CEP + CEV.

In this equation, the cost of the prime equipment is the sum of the following.

6.1.1.1 Cost to Develop Prime Equipment. CED, the cost to develop the prime equipment is developed by the following FORTRAN equation:

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                                              -34-
                        COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                         USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                         MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                            ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.
UNIT - CLASS 3 LRU NO. 1                                                          ANALYSIS - THREE LRU CLASSES
   TOTAL                                                                            DATE - JANUARY 2,1977


PRESENT VALUE COST TOTAL
EACH       CUM
    XI        XII        THOUSANDS OF DOLLARS
PRIME     T.E.       TE SPACE MANPOWER  SUPPLY     ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
    I         II         III       IV        V          VI        VII       VIII       IX        X


PROVISION       INITAL BUY                                   CONSUMED           RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART                        UNIT  MODULE PART UNIT  MODULE PART


TEST EQUIPMENT AND REPAIR CHANNEL DATA
                DIRECT                                  GENERAL                                 DEPOT
     T.E.                         REPAIR    T.E.                           REPAIR    T.E.                            REPAIR
     EACH       CUM       EACH      CUM     EACH       CUM       EACH        CUM     EACH       CUM       EACH         CUM


ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
           DIRECT                        GENERAL                                 DEPOT
T.E.      TE MEN     REP MEN   T.E.      TE MEN    REP MEN   T.E.      TE MEN    REP MEN

ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
            DEPOT
T.E.      TE MEN     REP MEN


EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH       CUM
    XVI       XVII        MANPOWER      XIII      D LTA       XIV       PV DELTA      XV
INITIAL PROVISION QUANTITIES OF
                      UNITS                                         MODULES                                 PARTS
  EQPT.      DIRECT    GENERAL       DEPOT         DIRECT     GENERAL     DEPOT        DIRECT     GENERAL      DEPOT

COST OF INITIAL PROVISION                                         RESIDUAL
        EQPT.         DIRECT       GENERAL      DEPOT       TOTAL
UNIT    XVIII          XIX          XX          XXI         XXII      XXIII
MODULE                XXIV          XXV         XXVI        XXVII     XXVIII
PART                  XXIX          XXX         XXXI        XXXII     XXXIII
```

Figure 19. LRU output page. (Roman numerals refer to costs normally printed on the corresponding space and are keyed to the text.)

CED = CEND * AMPEAT and (by substitution)

CED = CEND * AMULT * REPEAT.

All of the values to the right of the = sign of this last equation are values input directly by the analyst, namely:

CEND = $ to develop the LRU.

AMULT = reciprocal of the units in which cost is to be printed.

REPEAT = the number of different types of LRUs which this particular LRU data set represents.

6.1.1.2 Cost of Deployed Equipment. CEP, the cost of the deployed prime equipment CEP is developed as follows:

CEP = EDEE * UCUP * SPE * AMPEAT + CPE * AMPEAT

and, by substitution:

CEP = (ED * EE * CUP * SPE * + CPE) * AMULT * REPEAT .

This equation represents the sum of the repeating costs (ED * EE * CUP * SPE) and the nonrecurring (setup) costs of production (CPE) multiplied by common cost multipliers to translate costs into the agreed-upon common cost unit. All of the units to the right of the = sign are input directly by the analyst and represent the following:

ED = the number of prime equipments deployed.

EE = the number of identical (simultaneously used) LRUs per prime equipment.

CUP = the purchase cost of each LRU.

SPE = the fraction of CUP (or sum of CUP) that is not "sunk", i.e., not already irretrieveable regardless of the analysis results.

CPE = one-time (nonrecurring) costs of procurement.

6.1.1.3 Salvage Value. CEV is the salvage value of the deployed (recurrent) costs of 6.1.1.2 and is, therefore, assigned a negative value because it is deducted from the total cost at the program's end.

CEV = -SVE * ED * EE * CUP * SPE * AMULT * REPEAT .

All of the terms to the right of the = sign are inputs whose value is assigned directly by the analyst.

SVE is the fraction of the original value expected to be realizeable at the end of the program (Appendix B).

6.1.2 Test Equipment Cost (II of Figure 19). This cost is represented by the mnemonics VV(4) or CTST. This cost is developed as follows:

VV(4) = CTST = CTSD + CTSP + CTSR + CTSOFT + CTSV .

Thus, the cost of test equipment is made up of the sum of the following.

6.1.2.1 Cost to Develop Test Equipment. CTSD = the cost of developing the test equipment (all types). This development cost is:

CTSD = AMULT * (CI + CII + CCAL + CCSP). All of these cost elements are values input directly by the analyst, namely:

AMULT is the reciprocal of the units of cost desired. CI and CII are the input costs (in dollars) for the development of Type I and Type II test equipment. (Type I test equipment is of a type that may be used at any of the field locations or Depot. Type II test equipment is more complex and is of a type that would be used in Depot only.

CCAL = input cost (dollars) to develop a calibration system.

CCSP = input cost (dollars) to develop test equipment used by contact support teams.

6.1.2.2 Test Equipment Acquisition Costs. CTSP represents the cost to acquire all types of test equipment. This cost is developed as follows:

CTSP = (((DSU + GSU + DEP) * CPI) + (DEPAIE * CPII) + (ECAL *

CALSET * CCALP) + (EACSP * CONTCT * CCSPP)) * AMULT .

This equation can be broken down into more easily digestible parts. It really represents the sum of four component costs, all multiplied by AMULT as follows:

a) DSU + GSU + DEP is the sum of the channels of test equipment at the Direct Support Unit (DSU), General Support Unit (GSU), and Depot (DEP) that applies to the particular (Type I) test equipment. If integerized (EVOT = 0), it represents a whole number of Type I test equipments required. If not integerized, it represents the average (expected value) of the number of Type I test equipments. Whenthis sum is multiplied by CPI, the input cost per Type I test equipment, then (DSU + GSU + DEP) * CPI represents the cost of all Type I test equipment.

b) Similarly DEPAIE * CPII represents the investment in Type II test equipment (at the Depots).

c) EACAL * CALSET * CCALP is the product of three direct inputs whose values are assigned by the analyst to determine the investment in calibration equipment.

d) EACSP * CONTCT * CCSPP is likewise a produce of direct inputs that represent the investment in Contact Support Team Test Equipment.

e) The sums of (a) through (d) multiplied by AMULT provide the test equipment costs in the desired units.

6.1.2.3 Test Equipment Support. CTSR represents the support cost for all test equipment. The value of this mnemonic is the result of the following equation:

CTSR = (((DSU + GSU + DEP) * CRI + (DEPAIE * CRII) +

(EACAL * CALSET * CCALR) + (EACSP * CONTCT * CCSPR)) * YR

* AMULT) + CMPRT .

a) DSU + GSU + DEP again represent the total number of Type I test sets needed. Multiplying this sum by CRI (a direct input for the yearly material cost to maintain Type I test equipment) provides the yearly material costs of supporting Type I test equipment.

b) DEPAIE, the number of Type II test channels, multiplied by CRII (a direct input) provides the annual material cost to support Type II test equipment.

c) CCALR, a direct input is specified as the yearly cost to support a calibration test set per year. Multiplying this value by the number of such testsets provides the total yearly cost to support all calibration equipments. The value of EACAL, being either a zero or unity, acts as a switch to include or exclude the resulting cost calculation.

d) The annual cost to support the Contact Team Test Equipment is calculated by the product of direct inputs with EACSP being the switch controlling the inclusion or exclusion of the cost.

e) The costs (a) through (d) are added, multiplied by YR (the number of years the system is to be supported) to provide the total of the four support costs over YR years. This in turn is multiplied by AMULT (to convert to the desired units of cost. Now CMPRT, the manpower support costs must be added.

f) CMPRT = (168. * YR 8 * AMULT) * ((ETI * FI * ((OD * CDMAN * TDMAN * (SAOY/WOM)) + (DI * CGMAN * TGMAN * (SAIY/WIM)) + ((1 - AAIE) * TDPMI * CDPMAN * (SADY/WDM)))) + (ETII * FII * AAIE * TDPMII * CDPMAN * (SADY/WDM))) .

Each of the fractions SAOY/WOM, SAIY/WIM, SADY/WDM represents the work hours required for each clock hour divided by the number of hours per week each man works at the Direct, General, and Depot respectively. When multiplied by 168 hours in each week, this provides the number of men required. Multiplying each of these by the appropriate cost per manyear (CDMAN, CGMAN, CDPMAN) and by the number of years provides the total manpower cost at each type of test station over YR years. The fractions of this cost that should be applied to the support of the test equipment itself are FI (for all Type I test equipment at Direct, General, and Depot) and FII (for Type II test equipment at Depot only). The other multipliers OD, DI, 1.-AAIE and AAIE represent how many Type I and Type II test stations are to be located at each location and the factors such as TDMAN, TGMAN, TDPMI, and TDPMII modify each of the manpower requirements by their value (input by the analyst to represent the productivity or size of each type and location of crew).

6.1.2.4 Cost of Software. CTSOFT represents the cost of test equipment software (programming of automated test equipment)

CTSOFT = (CLRUPG + P * CMODPG + (CPUBII + CALPUB + CTCPUB)) * AMULT * REPEAT.

All of the elements on the right hand side of the = sign are direct inputs whose values are assigned by the analyst. The equation represents the sum of the following costs:

a) CLRUPG = the cost to program Type I test equipment for LRU repair.

b) P * CMODPG = the number of "module" types multiplied by the cost to program for each module to be tested and repaired.

c) CPUBII, CALPUB, CTCPUB = the cost to assembly the technical data for Type II, calibration and the cost for contact team test equipment data, respectively.

d) The preceding sum is multiplied by AMULT and REPEAT to obtain costs in the units required.

6.1.2.5 Salvage Value. CTSV = the salvage value of the test equipment at the end of the program. It is defined as a negative quantity, namely:

CTSV = -CTSP * SVT .

CTSP has been defined in 6.1.2.2 as the acquisition cost of all test equipment. SVE is a direct analyst input representing the fraction of the total value remaining at the program's end.

6.1.3 Cost of Facilities (III in Figure 19). CFT (or VV(5)) the cost of facilities for the test equipment is the result of the following FORTRAN sequence:

VV(5) = CFT = CFR = (CFTD*((DEP*FTI) + (DEPAIE * FTII))) * AMULT * YR * 12.

a) CTFD is the analyst's input of $/square foot/month for test space at Depot.

b) DEP is the number of Type I test stations needed at Depot (DEP is a calculation described in Paragraph 6.1.2.2).

c) FTI is the square feet required per Type I test station as input by the analyst.

d) DEPAIE is similar to DEP and refers to the number of Type II test equipment stations needed.

e) FTII is the analyst's input of the number of square feet required per Type II test station. Thus:

(DEP * FTI) = number of square feet/Type I test station.

(DEPAIE * FTII) = number of square feet/Type II test station.

(CFTD * ((DEP * FTI) + (DEPAIE * FTII))) = $/month for both types of Depot test equipment.

Multiplying by 12 converts to dollars/year; multiplying by AMULT changes the results to the desired multiple of dollars. Finally, multiplying by YR provides the total cost over YR years.

6.1.4 Personnel Costs (IV of Figure 19). CMPT or (VV(6)) is the cost of the personnel. The cost is developed by the FORTRAN expression:

VV(6) = CMPT = CMPPY + CMPR + CMPRR.

This expression says that the manpower cost of operating the test equipment is the sum of:

a) CMPPY is the cost of setting up training courses.

b) CMPR is the cost of the test equipment related personnel, including training.

c) CMPRR is the total cost of repair personnel.

6.1.4.1 The Cost to Set Up Training Courses. CMPPY = ((ETI * CTRI) + ETII * CTRII) + (EACAL * CTRCAL) + (EACSP * CTRSPT)) * AMULT .

Every term to the right of the = sign is input directly by the analyst. ETI, ETII, EACAL, and EACSP are all "posting" controls (value either unity or zero) which control the use of the printing of the associated input. They refer to Type I, Type II calibration and contact support team test equipment. In the same sequence CTRI, CTRII, CTRCAL, and CTRSPT are the one-time costs to set up training courses for the respective test sets. Each set of products then is the one-time cost to set up a training course. Adding the four products and multiplying by AMULT converts costs into the desired cost units.

6.1.4.2 The Cost of Test Equipment Personnel. CMPR = (((DSUM * CDMAN * TDMAN) + (GSUM * CGMAN * TGMAN) + (CDPMAN * ((DEPM * TDPMI) + (DEPAIM * TDPMII))) + (EACAL * CALSET * CALMAN * TALMAN) + (EACSP * CONTCT * CONMAN * TONMAN)) * YR * AMULT)-CMPRT + TRNG + CMANE.

This equation consists of five sets of products, added, converted to the desired units, and then reduced by CMPRT (total manpower costs for supporting test equipment) and increased by the cost for training test equipment people and the cost for training the contact support teams).

a) DSUM * CDMAN * TDMAN is a product that provides the cost per year for manpower operating the Direct test equipment. DSUM represents the number of Direct Support manpower needed to meet the expected load, including that labor necessary to maintain the test equipment itself. This is in terms of the number of crews required. When multiplied by TDMAN (an input meaning effective crew size) the product provides a quantity of direct manpower. Multiplying by CDMAN (an input of the cost of each man per year at Direct) provides a total yearly cost of direct manpower. Similarly:

   1) GSUM * CGMAN * TGMAN is the yearly manpower cost at General Support.

   2) (CDPMAN * ((DEPM * TDPMI) + (DEPAIM * TDPMII))) is the yearly cost of Depot manpower for both Type I and Type II equipment. All of the mnemonics are direct inputs except for DEPM and DEPAIM. These two represent respectively the fractional manpower required for Type I and Type II test equipment personnel. The entire expression thus represents the yearly cost for Type I and Type II test equipment manpower.

   3) EACAL * CALSET * CALMAN * TALMAN is the yearly cost of manpower on the calibration equipment.

4) EACSP * CONTCT * CONMAN * TONMAN provides the cost of contact team by multiplying a posting flat (EACSP) by the number of teams needed (CONTCT) by the yearly cost per team member (CONMAN) by the number of personnel in each crew (TONMAN). These are all inputs whose value is determined by the analyst.

The sum of the preceding products multiplied by the input number of years (YR) and AMULT provides the overall cost in the desired units. However, as was pointed out previously, DSUM (and similarly GSUM, DEPM, and DEPAIM) includes the manpower needed for self-support.

b) Consequently, the manpower costs related exclusively to the support of the test equipment (CMPRT) are subtracted from the total.

c) TRNG, the cost of training Direct, General, Depot (Type I), Depot (Type II), Calibration, and Contact Test Equipment people is added.

d) Finally, CMANE, the cost of labor at the equipment, is added. CMANE is derived from:

CMANE = (CUCE * ED * OTF * (SMF + (1. -SMF) * AYZ * TRC * TU)) *

YR * AMULT * REPEAT .

This form of the equation reduces the equation to those items that are direct inputs whose values are set by the analyst. CUCE, the around the clock manpower cost is charged only to the extent that it is used in scheduled maintenance (SMF) and to the extent that the time not spent in scheduled maintenance is demanded by failure (1. -SMF) * AYZ * TRC * TU. Thus CUCE * ED * OTF * SMF represents the "CUCE" cost attributable to scheduled maintenance while CUCE * ED * OTF * (1. -SMF) * AYZ * TRC * TU represents the "CUCE" cost attributed to demand (TU), as modified by the availability (AYZ) and multiplied by the time spent on each demand (TRC). AYZ enters the equation because as pointed out earlier, unavailable equipment does not create demand for service.

6.1.4.3 <u>The Cost of Repair Personnel</u>. CMPRR = YR * AMULT * ((DSUR * CDRMAN * TDRMAN) + (GSUR * CGRMAN * TGRMAN) + (DEPR * CDPRMN * TDPRI) + (DEPAR * CDPRMN * TDPRII)) + TRNGR.

This is the cost of repair personnel and is analogous to 6.1.4.2. That is, the expression represents the sum of four products. (DSUR * CDRMAN + TRDMAN) is one such product. Each product represents the cost of a different repair crew, namely:

DSUR = $/Year for Direct repair crew.

GSUR = $/Year for General repair crew.

DEPR = \$/Year for Depot (Type I) repair crew.

DEPAR = \$/Year for Depot (Type II) repair crew.

Each product represents the product of the number of crews (DSUR), \$/year/person (CDRMAN) and people per crew (TDRMAN). Those products are added, multiplied by AMULT and YR to obtain total cost in AMULT units. To this is added the cost to train the repair people (TRNGR).

6.1.5 Cost of Supply (V of Figure 19). Cost of supply (CIVT or VV(7)) is the result of:

VV(7) = CIVT = CIVP + CIVR + CSVR + CIVV

which is the sum of the costs of inventory (CIVP), cost of consumed material (CIVR), cost of salvage of consumed material (CSVR) and the cost of salvage of any remaining material at the end of the program.

6.1.5.1 Cost of Inventory. CIVP, the cost of the inventory, is given by:

CIVP = SPEV * AMULT * REPEAT * ((CUP * QT) + (P * CMP * QTM) +

(PP * FNSP * CPP * QTP))

in which all of the items to the right of the = sign are direct inputs whose values are set by the analyst, except for QT, QTM, QTP which represent the quantities of LRU, module (per type) and part (per type) to be stocked as derived in Section 6.2.

a) CUP * QT is the cost of LRUs (this LRU type).

b) P * CMP * QTM is the cost of all types of modules stocked for the LRU.

c) PP * FNSP * CPP * QTP is the cost of all parts that are not standard parts (FNSP).

d) The sum of (a), (b), and (c) multiplied by AMULT and REPEAT convert to the cost units and include the cost of items this LRU represents. Including SPEV assures that there is no charge for those costs already "sunk."

6.1.5.2 Cost of Consumed Material. CIVR = AMPEAT * ((YR8*QUA * FMWO * CKIT) + (SPEVR * ((UCUR * QC) + (P * UCMR * QCM) + (PP * FNSP * UCPR * QCP)))) or, by substitution

CIVR = AMULT * REPEAT * ((YR * QUA * YMWO * CKIT) + SPEVR *

((CUP * QC) + (P * CMP * QCM + (PP * FNSP * CPP * QCP)))).

Again, everything to the right of the = sign except for the consumed quantities of LRUs (QC), modules (QCM), and the deployed units (QUA) are inputs whose values are set by the analyst directly.

a) CUP * QC is the cost of consumed units (this LRU).

b) P * CMP * QCM is the cost of consumed modules - all module types involved with this LRU type.

c) PP * FNSP * CPP * QCP is the cost of all consumed nonstandard parts associated with this LRU type.

d) Multiplying the sum of the above cost elements by SPEVR relieves the user of the "sunk" costs — those costs spent regardless of the outcome of the analysis.

e) QUA * YMWO provides the total number of kits per year. Multiplying this by YR produces the total number of kits needed over the life of the equipment. Multiplying by the cost per kit (CKIT) gives the total kit cost.

f) All of the above costs are added and multiplied by AMULT and REPEAT to produce total costs in the desired units.

6.1.5.3 <u>Cost of Salvaged Consumed Material</u>. CSVR = -SVR * CIVR.

CIVR was explained previously (Section 6.1.5.2) and multiplying that value by -SVR (an input) produces the negative cost of salvage value of consumed material.

6.1.5.4 <u>Cost of Salvaged Unconsumed Material</u>. CIVV = -SVV * (CRUT + CRMT + CRPT) which by substitution, becomes:

CIVV = -SVV * (CUP * REPEAT * AMULT * (QT - QQC) + CRMT + CRPT) .

QT (the total supply of LRUs) minus QQC (LRUs consumed over and above the original supply) is the quantity not consumed. Multiplying by REPEAT and AMULT obtains the value of unscrapped LRUs. Similar logic applied to CRMT and CRPT provides the value of unscrapped modules and parts. Multiplying their sum by -SVV supplies the negative cost this material represents.

6.1.6 Ofdering Costs (VI in Figure 19). VV(8) = CROT = CROR = SPEVR * AMPEAT * ((CRU * (QC/QB)) + (P * CRM * (QCM/QBM)) + (PP * FNSP * CRP * (QCP/QBP))). This says that the reordering costs are the costs to reorder LRUs plus the costs to reorder modules plus the cost to reorder parts all multiplied by AMPEAT (REPEAT * AMULT) and SPEVR the "sunk" cost factor for consumed material. The similarity of the following terms is noted:

a) LRU reorder costs CRU * (QC/QB).

b) Module reorder costs P * CRM * (QCM/QBM).

c) Parts reorder costs PP * FNSP * CRP * (QCP/QBP).

The parts reordering costs are the most complex and will be explained. The other two cost components follow the same logic. The fraction QCP/QBP is the number of consumed parts divided by the reorder quantity to produce the number of reorder actions per part number.

Multiplying by PP (the number of unique part numbers in the LRU) converts to the total number of reorder actions for all part numbers.

Multiplying by FNSP rules out the reorder action for standard parts (for which the program will not be charged).

Finally, multiplying by the cost of each reorder action (CRP) converts the information to cost to reorder parts.

The costs for reordering LRUs and modules are obtained in a similar manner, added together, multiplied by REPEAT to account for similar LRUs, by AMULT to convert to the desired cost units, and by SPEVR to permit the "sinking" of some fraction of the total costs.

6.1.7 Cost of Storage (VII of Figure 19). Storage costs are given by:

VV(9) = CWHT = CWHR = AMPEAT * YR12 * ((CSDSU * ((CUBEU * QTO) +

(P * CUBEM * QTMO) + (PP * CUBEP * FNSP * QTPO))) +

(CSGSU * ((CUBEU * QTI) + (P * CUBEM * QTMI) + (PP *

CUBEP * FNSP * QTPI))) + (CSDEP * ((CUBEU * QTD) +

(P * CUBEM * QTMD) + (PP * CUBEP * FNSP * QTPD)))) .

Basic to this computation is the multiplication of the volume of each item (CUBEU for LRUs) and quantity of items to be stocked at the Direct, General, and Depot support locations. For LRUs, this quantity is QTO, QTI, and QTD, respectively. For modules, the number of module types per LRU (P) and for parts, the number of part types per LRU must be included in the multiplication. This multiplication provides the total volume of storage space for each type of item (LRU, module, or part) at each location. These volumes are added by location ((CUBEU * QTO) + (volume required for modules and parts at Direct Support)) and multiplied by the appropriate cost (dollars per cubic foot per month at Direct (CSDSU), at General (CSGSU), and at Depot (CSDEP) to obtain the three possible storage costs. Because these costs are in dollars per month, they are multiplied by YR12 (the number of months over which support is to occur) to convert to total dollars for this LRU type. AMPEAT, the

other multiplier, converts to total cost in acceptable unit cost because it is the product of AMULT and REPEAT.

6.1.8 Cost of Supply Administration (VIII of Figure 19). VV(10) = CSAT = CSAP + CSAR. This equation says that the cost of supply administration is the sum of CSAP (cost to enter items into the supply system) and CSAR (cost to maintain an item in the supply system). Entry costs are one-time costs while maintaining costs occur annually. Each non-standard item must be entered once and maintained annually.

6.1.8.1 Cost to Enter Items in Supply. CSAP = CSMULT * CEN which by substitution becomes:

CSAP = CEN * (1. + (P * AQM) + (PP * FNSP * AQP)) * REPEAT * AMULT

CSAP = CEN * (1. + (P * QTM) + (PP * FNSP * QTP)) * REPEAT * AMULT.

That portion within the major parentheses represents the quantity of items: one LRU, (P * QTM) modules, and (PP * FNSP * QTP) parts. All of these items except the one, QTM and QTP are inputs whose values are set directly by the analyst. There is one LRU type, QTM modules per module type (P), and QTP parts per part type (PP) per LRU type. Multiplying this quantity by the cost to enter an item (CEN) creates the value of the cost to enter all items needed for this LRU into the supply system. Multiplying by REPEAT creates the cost for all represented modules (in dollars) and multiplying by AMULT puts the cost in the desired units.

6.1.8.2 Cost to Administer Supply. CSAR = CSMULT * CAD * YR

CSMULT is the same as determined in 6.1.8.1 and represents the total quantity of items (LRUs, modules, parts) to be handled and includes the cost unit multiplier. CAD is an input whose value of dollar/item/year is set by the analyst and YR is the number of years (also input). The product then is the total on-going cost of keeping all items represented by this LRU in the supply system over YR years.

6.1.9 Shipping Costs (IX of Figure 19). Shipping cost for the LRUs is given by:

VV(11) = CSHT = CSHR = AMPEAT * ((YR8 * QUA * WTKIT * SHKIT) +

(ONTIME * ((WU * SHU) + (WM * SHM) + (WP * SHP)))) .

6.1.9.1 Modification Kit Shipping Cost. This cost includes the cost of shipping modification kits (YR8 * QUA * WTKIT * SHKIT) which by substitution becomes (YR * QUA * WTKIT * YMWO * (CDFD + (CDDI * (ZO + Z1)) + CDIO * ZO)). All of the preceding are inputs whose values are set directly by the analyst (except for the quantity deployed, QUA).

AD-A039 474 RCA GOVERNMENT SYSTEMS DIV BURLINGTON MASS AUTOMATED--ETC F/G 5/1
LOCAM 5, PROGRAMMER/USER'S MANUAL. VOLUME II.(U)
FEB 77 E C SEABERG, R E HOWE DAAH01-76-C-1071
UNCLASSIFIED CR-76-588-019-VOL-2 DRDMI-D-77-2 NL

2 OF 3
AD
A039474

All kits go from factory to Depot and incur shipping cost (1 * CDFD). ZO + ZI is the fraction of the total kits that go on to General Support and incur cost CDDI. ZO is the fraction of the kits that go on to Direct Support and incur cost CDIO. These are summed and multiplied by:

a) WTKIT changes costs from dollar/pound to dollar/kit.

b) YMWO * QUA, the number of kits per year creates costs in dollars per year.

c) YR provides total kit shipping costs in dollars for this LRU over YR years.

6.1.9.2 Repair and Replacement Shipping Costs. Costs for shipping units modules and parts (for repair and/or replacement) are covered by the expression:

(ONTIME * ((WU * SHU) + (WM * SHM) + (WP * SHP))) in which:

a) ONTIME represents the total unit hours that all of these types of LRUs may be expected to log during YR years.

b) WU, WM, and WP are the shipping weights (in pounds per LRU, modules, and parts, respectively).

c) SHU, SHM, SHP represent the dollars per pound per hour being spent in shipping LRUs, modules, and parts, respectively. When multiplied by the weight of the item, the resulting product yields the cost involved in shipping during any hour for a single item. Multiplication by ONTIME then converts to shipping cost for the LRUs, modules, and parts. This cost plus the cost of shipping the modification kits (6.1.9.1) is then multiplied by REPEAT and AMULT to convert to the desired cost units for all LRUs represented.

6.1.10 Grand Cost Total (X of Figure 19). "Total" is, as the name implied, the sum of costs computed in 6.1.1 through 6.1.9. It is generated by the statement:

VV(11) - GCT = CD + CP + CR + CS

which, by substitution is

GCT = CED + CTSD + CTSOFT + CEP + CTSP + CIVP + CSAP + CMPPY +

CTSR + CFR + CMPR + CMPRR + CIVR + CROR + CWHR + CSAR +

CSHR + CSVR + CEV + CTSV + CIVV .

These have all been previously defined as:

CED: (Section 6.1.1.1, cost to develop prime equipment).

CTSD: (Section 6.1.2.1, cost to develop test equipment).

CTSOFT: (Section 6.1.2.4, cost to develop test equipment software).

CEP: (Section 6.1.1.2, cost of deployed prime equipment).

CTSP: (Section 6.1.2.2, cost of deployed test equipment).

CIVP: (Section 6.1.5.1, cost of inventory).

CSAP: (Section 6.1.8.1, cost to enter inventory item in supply).

CMPPY: (Section 6.1.4.1, cost to set up training courses).

CTSR: (Section 6.1.2.3, cost to support test equipment).

CFR: another designation for CFT (Section 6.1.3, cost of facilities for support).

CMPR: (Section 6.1.4.2, cost of test equipment related personnel).

CMPRR: (Section 6.1.4.3, cost of repair personnel).

CIVR: (Section 6.1.5.2, cost of consumed material).

CROR: another designation for CROT (Section 6.1.6, cost of reordering material).

CWHR: another designation for CWHT (Section 6.1.7, cost to store material).

CSAR: (Section 6.1.8.2, cost to administer supply).

CSHR: another designation for CSHT (Section 6.1.9, cost of shipping and handling).

CSVR: (Section 6.1.5.3, cost of the salvaged consumed material).

CEV: (Section 6.1.1.3, cost of salvaged deployed equipment).

CTSV: (Section 6.1.2.5, cost of salvaged test equipment).

CIVV: (Section 6.1.5.4, cost of salvaged unconsumed inventory).

6.1.11 Present Value Cost Total (XI of Figure 19). The present value cost (PVGCT or VV(1)) is a recognition that time has a dollar value or, to put it another way, that the user of the system being

investigated has other needs for his money and desires to invest the money in the most advantageous way. The result of this is that the time phasing of costs becomes important. The normal sequence for the expenditure of a program's funds is as follows:

a) Development (CD).

b) Acquisition (CP).

c) Operation and Maintenance (CR).

d) End of Program Salvage (CS).

All of these are known from the description of cost items (Figure 19) and are defined as follows:

a) CD = CED + CTSD + CTSOFT.

b) CP = CEP + CTSP + CIVP + CSAP + CMPPY.

c) CR = CTSR + CFR + CMPR + CMPRR + CIVR + CROR + CWHR + CSAR + CSHR + CSVR.

d) CS = CEV + CTSV + CIVV.

All of these costs have been previously investigated and discussed as noted in Section 6.1.10.

The value of money with respect to time is input as FINT, the annual interest rate fraction. The program assumes that the present value of each of the spending phases is the "constant dollar" value just computed and equates them as follows:

PVCD = CD

PVCP = CP

PVCR = CR

PVCS = CS .

The preceding statements are true and remain true if the value assigned to the annual interest rate is zero. Regardless, the program assigns cost growth factors, namely:

PART = 1. + FINT

PART 1 = PART * * YD

PART 2 = PART * * YP

PART 3 = PART * * (-YR)

PART 4 = PART * * (YZ):

PART is the annual growth rate of cost (or the value of the money on hand).

PART 1 is the multiplier for the development money. Thus, if there is CD on hand at the beginning of the development stage, that money would be worth CD * PART 1 = CD * (1.+ FINT) * * YD at the end of the development stage.

LOCAM 5 computes present value at the start of the O&M phase; however, YZ permits this to be offset to any other time in the schedule. If YZ is negative, the time is shifted forward because:

(CD * (1. + FINT) * *YD) * (1. + FINT) * * (-YZ)

is smaller than if the last term were (+ YZ). Similarly, if YZ were zero (1.+ FINT) * * (YZ) would have no shifting effect at all.

6.1.11.1 Development Present Value. PVCE = (CD/YD) * ((PART 1 - 1.)/FINT)* PART 4 * PART 2. The amount spent annually for development (CD/YD) gathers interest as an annuity over the YD period (PART 1) and is carried as a fixed interest bearing sum over the production period to the beginning of O&M (by PART 2) unless modified by PART 4 (if YZ ≠ 0).

6.1.11.2 Acquisition. PVCP = (CP/YP) * ((PART 2-1.)/FINT) * PART 4

This is exactly analogous to PVCD except that at the end of the acquisition period there is no carrying of the amount as a fixed interest bearing sum because the reference time is the end of acquisition or beginning of O&M (unless modified by PART 4 with YZ ≠ 0.).

6.1.11.3 Operation and Maintenance. PVCR = (CR/YR) * ((1. - PART 3)/FINT) * PART 4

Again, this is analogous to PVCD but the spending takes place on the other side of the acquisition/O&M reference point (PART 3 < 1) because the exponent is -YR). Unless this reference point is moved by making YZ ≠ 0. (and PART 4 ≠ 1.), there is no amount carried at a fixed interest rate.

6.1.11.4 End of Life Salvage Credit. PVCS = CS * PART 3 * PART 4

Because this money is acquired as a lump sum rather than over a period of years, there is no annuity factor. It is carried as a fixed interest bearing sum over the O&M period (in a negative direction timewise) unless modified by PART 4.

6.1.11.5 Present Value Total. The total, at present value is:

VV(1) = PVGCT = PVCE + PVCP + PVCR + PVCS .

6.1.12 Cumulative Present Value Cost Total (XII of Figure 19). PCGT or VV(2)) is the accumulated value of PVGCT. This value keeps building with every successive LRU processed namely: VV(2) = PCGT = PVGCT + PCGT. Initially, PCGT = 0 as the result of a statement in the BLOCK DATA. Successive resets are under control of the analyst's use of IS values in NAMELIST/L/.

6.1.13 DELTA (XIII of Figure 19). DELTA (or VV(62)) represents the difference between the expected value and the computed manpower costs. Because computed manpower costs may very well have been computed as expected value, DELTA may be zero. If computed manpower costs have been computed as whole numbers of people, then DELTA may exist. The definition of DELTA is as follows:

DELTA = YR * AMULT * ((CDMAN * TDMAN * (DSUM-(168. * OD * (DSUY/

(WOM))))) + (CDRMAN * TDRMAN * (DSUR -(168. * OD *

(DSURY/(WOR))))) + (CGMAN * TGMAN * (GSUM -(168. *

DI * (GSUY/(WIM))))) + (CGRMAN * TGRMAN * (GSUR - (168. *

DI * (GSURY/(WIR)))))) .

In the preceding expression, DSUM, DSUR, GSUM, GSUR are expressions that are not input directly by the analyst. They are computed (whether expected value or integer people) values of the people needed at the Direct Test, Direct Repair, General Test, and General Repair stations respectively. DSUY, DSURY, GSUY, GSURY are similar numbers but regardless of the method the analyst chooses to compute his manpower costs, these values are always the expected value of the personnel; they are hours per clock hour work load required at each station. Dividing those values by the hours each crew works per week (direct input WOM, WOR, WIM, WIR) provides the expected value of the number of crews per station. Multiplying this result by the number of hours per week (168) and by the number of each type of station (OD, DI) provides the total expected value of the number of crews (GSUM, etc.). Subtraction from DSUM, etc. results in the difference between the computed crews and the expected value of crews of each type. Each of these values, when multiplied by the number of men per crew (TDMAN, etc.) and the annual cost per crew (CDMAN, etc.) results in four possible annual costs (at the respective locations). These four costs added together and multiplied by the number of years (YR) result in the DELTA or difference in costs. Multiplying by AMULT yields costs in the desired units.

6.1.14 Expected Value of Manpower (XIV of Figure 19). ECMPT (or VV(61)) is defined as ECMPT = CMPT - DELTA which can be recognized from Section 6.1.4 as the cost of personnel minus the DELTA (the additional personnel costs accrued as a result of the chosen method of computing personnel costs). ECMPT then is the expected value of personnel costs.

6.1.15 Present Value DELTA (XV of Figure 19). PDELTA (or VV(63)) is defined as follows:

PDELTA = (DELTA/YR) * FACTOR

which, by substitution becomes:

PDELTA = (DELTA/YR) * ((1-PART 3)/FINT) * PART 4

which can be recognized as spreading the average yearly amount of DELTA (XIII of Figure) over YR years as an annuity and that total amount modified as needed by PART 4 (if YZ $\neq$ 0). In other words, it is the present value of DELTA.

6.1.16 Expected Value Grand Cost Total (XVI of Figure 19). EPVGCT, the expected value of the Support manpower expenditures, EPVGCT (or VV(59)), is the difference between the expected value of the grand cost total (XI of Figure 19) of the LRU and the PDELTA. That is, it represents the present value of the grand cost total for the LRU (and those LRUs it represents). It is defined as:

VV(59) = EPVGCT = PVGCT-PDELTA

in which, PVGCT has been defined per Section 6.1.11 and PDELTA has been defined per Section 6.1.15.

6.1.17 Cumulative Present Value Cost Total (XVII of Figure 19). SEPV (or VV(60)) is the present value sum of all LRUs up to the current LRU. As with PCGT (6.1.12), the value builds with each successive LRU processed. It is initialized to SEPV = 0 as the result of a statement in BLOCK DATA. Successive resets are made under control of the analyst's use of the IS value in NAMELIST/L/.

6.1.18 Cost of LRU Supply at the Equipment (XVIII of Figure 19). The cost of initial provision of LRUs at the equipment location(s) is designated as CQTE and is defined as:

CQTE = QTE * UCUP * AMPEAT

which, by substitution becomes

CQTE = QTE * CUP * AMULT * REPEAT .

This is an expression, most of whose terms have been dealt with before:

a) QTE represents the quantity of LRUs to be stocked at all possible equipment support locations.

b) CUP represents the cost of each LRU.

c) AMULT and REPEAT have been previously defined in Section 6.1.1.

6.1.19 Cost of LRU Supply at Direct Support (XIX of Figure 19). The cost of initial provision of LRUs at the Direct Support location(s) is designated as CQTO and is defined as:

CQTO = QTO * UCUP * AMPEAT

which, by substitution becomes

CQTO = QTO * CUP * AMULT * REPEAT .

This is an expression, most of whose terms have been dealt with before:

a) QTO represents the quantity of LRUs to be stocked at all possible Direct Support locations.

b) CUP represents the cost of each LRU (Appendix B).

6.1.20 Cost of LRU Supply at General Support (XX of Figure 19). The cost of initial provision of LRUs at the General Support location(s) is designated at CQTI and is defined as:

CQTI = QTI * UCUP * AMPEAT

which, by substitution becomes

CQTI = QTI * CUP * AMULT * REPEAT .

This is an expression, most of whose terms have been dealt with before:

a) QTI represents the quantity of LRUs to be stocked at all possible General Support locations.

b) CUP represents the cost of each LRU.

6.1.21 Cost of LRU Supply at Depot (XXI of Figure 19). The cost of initial provision of LRUs at the Depot location(s) is designated as CQTD and is defined as:

CQTD = QTD * UCUP * AMPEAT

which, by substitution becomes

CQTD = QTD * CUP * AMULT * REPEAT .

This is an expression, most of whose terms have been dealt with before:

a) QTD represents the quantity of LRUs to be stocked at all possible Depot Support locations.

b) CUP represents the cost of each LRU.

6.1.22 <u>Total Cost of LRU Supply at all Locations (XXII of Figure 19)</u>. CQTT, the cost of the total LRUs initially stocked, is defined as:

CQTT = CQTE + CQTO + CQTI + CQTD .

That is, the total cost of LRUs initially stocked is the sum of the costs of the LRUs stocked at Equipment, Direct, General, and Depot levels (Sections 6.1.18, 6.1.19, 6.1.20, and 6.1.21).

6.1.23 <u>Cost of Residual Spare LRUs (XXIII of Figure 19)</u>. CRUT is the cost of the residual spare LRUs at the end of YR years:

CRUT = UCUP * RU * AMPEAT

which, by substitution becomes

CRUT = CUP * (QT-QQC) * AMULT * REPEAT

in which all but (QT-QQC) are direct inputs:

a) CUP = cost of an LRU.

b) (QT-QQC) which may not be less than zero, is the difference between the total quantity of LRUs initially stocked and the quantity consumed over YR years.

6.1.24 <u>Cost of Module Supply at Direct Support (XXIV of Figure 19)</u>. CQTMO is the total cost of modules initially stocked at the Direct Support location. It is defined as:

CQTMO = P * UCMP * QTMO * AMPEAT

or

CQTMO = P * CMP * QTMO * AMULT * REPEAT .

In this equation:

a) P is the number of types of modules used in the LRU.

b) CMP is the cost of the typical module.

c) QTMO is the quantity of each module type to be stocked at all Direct Support locations for the represented LRU.

6.1.25 Cost of Module Supply at General Support (XXV of Figure 19). The cost of initial provision of modules at General Support location(s) is designated as CQTMI and is defined as:

CQMTI = QTMI * UCMP * AMPEAT * P

which, by substitution becomes

CQMTI = QMTI * CMP * AMULT * REPEAT * P .

In this expression, most of the terms have been dealt with before:

a) QTMI represents the quantity of each module type to be stocked at all possible General Support locations (for this LRU).

b) CMP represents the cost of each typical module.

c) P is the number of different types of modules in the LRU.

6.1.26 Cost of Module Supply at Depot (XXVI of Figure 19). The cost of initial provision of modules at the Depot Support location(s) is designated as CQMTD and is defined as:

CQTMD = QTMD & UCMP * AMPEAT * P

which, by substitution becomes

CQTMD = QTMD * CMP * AMULT * REPEAT + P .

This is an expression, most of whose terms have been dealt with before:

a) QMTD represents the quantity of each module type to be stocked at all possible Depot Support location(s) for this LRU.

b) CMP represents the cost of each typical module.

c) P is the number of different module types in the LRU.

6.1.27 Total Cost of Initial Module Supply (XXVII of Figure 19). The total cost of all initially provisioned modules related to a representative LRU is given by:

CQTMT = CQTMO + CQTMI + CQTMD .

6.1.28 Cost of Residual Spare Modules (XXVIII of Figure 19). The cost of the residual modules is designated by the mnemonic CRMT. It represents the value of the positive difference between the initially stocked modules and those consumed over YR years. The value is defined as:

CRMT = P * UCMP * RM * AMPEAT

which, by substitution becomes

CRMT = P * CMP * (QTM-QQCM) * AMULT * REPEAT .

The terms are defined as follows:

a) P is the number of different types of modules in the represented LRU.

b) CMP is the cost of a typical module.

c) QTM-QQCM is the positive difference (minimum value = 0) between the numbers of modules initially stocked and the number consumed over YR years.

6.1.29 <u>Cost of Spare Parts at Direct Support (XXIX of Figure 19)</u>. The cost of initial provision of parts at the Direct Support location(s) is designated as CQTPO and is defined as:

CQTPO = QTPO * UCPP * AMPEAT * PP * FNSP

which, by substitution becomes

CQTPO = QTPO * CPP * AMULT * REPEAT * PP * FNSP .

This is an expression, most of whose terms have been dealt with before:

a) QTPO represents the quantity of each part type to be stocked at all Direct Support locations for the represented LRU.

b) CPP represents the cost of each typical part type.

c) PP is the number of different types of parts in each LRU represented.

6.1.30 <u>Cost of Spare Parts at General Support (XXX of Figure 19)</u>. The cost of initial provision of parts at the General Support location(s) is designated as CQTPI and is defined as:

CQTPI = QTPI * UCPP * AMPEAT * PP * FNSP

which, by substitution becomes

CQTPI = QTPI * CPP * AMULT * REPEAT * PP * FNSP .

This is an expression, most of whose terms have been dealt with before:

a) QTPI represents the quantity of each part type to be stocked at the General Support locations for the represented LRU.

b) CPP represents the cost of each typical part type.

c) PP is the number of different part types in each LRU represented.

6.1.31 Cost of Spare Parts at Depot (XXXI of Figure 19). The cost of initial provision of parts at the Depot Support location(s) is designated as CQTPD and is defined as:

CQTPD = QTPD * CPP * AMPEAT * PP * FNSP

which, by substitution becomes

CQTPD = QTPD * CPP * AMULT * REPEAT * PP * FNSP .

This is an expression, most of whose terms have been dealt with before:

a) QTPD represents the quantity of each part type to be stocked at all possible Depot Support locations.

b) CPP represents the cost of each typical part type.

c) PP is the number of different part types in the represented LRU.

6.1.32 Total Cost of Spart Parts (XXXII of Figure 19). The total cost of all initially provisioned parts related to a representative LRUs is given:

CQTPT = CQTPO + CQTPI + CQTPD .

6.1.33 Cost of Residual Spare Parts (XXXIII of Figure 19). The cost of the residual parts is designated by the mnemonic CRPT. It represents the value of the positive difference between the initially stocked parts and those consumed over YR years. The value is defined as:

CRPT = PP * UCPP * RP * AMPEAT * FNSP

which, by substitution becomes

CRMT = PP * CPP * (QTP-QQCP) * AMULT * REPEAT * FNSP .

The terms are defined as:

a) PP = the number of different types of parts in the represented LRU.

b) CPP = the cost of a typical part.

c) QTP-QQCP = the positive difference (minimum value = 0) between the numbers of parts initially stocked and the number consumed over YR years.

d) FNSP = fraction of total parts which are not standard parts.

6.1.34 Summarization of Costs. The previously defined costs, related to Figure 19, represented the individual LRU output costs.

Nearly all of the individual LRU costs are also summed for each "case" and, on command from the analyst, are printed out per Figure 20, the CASE TOTAL output page. This level of total is printed as the result of "NU = -1" input with the last LRU of the "case."

Summation of these summary costs (second level total) may also be output per Figure 21 which represents the GRAND TOTAL of the sum of the previous CASE TOTALS.

Both Figures 20 and 21 represent printouts of values of the mnemonics listed in the program's "COMMON/ZERO/" list; hence, the Roman numeral/mnemonic relationship is the same for both figures.

Prior to the printing of any Figure 20, the values are added into an array called SUM via a "DO" statement that specifies "SUM (I) = SUM (I) + CUM (I)" for all values of I from 1 through 35.

Because CUM is also an array that is equivalent to "COMMON/ZERO/," this statement adds the value of the mnemonic (or CUM(I)) to the proper location in the array SUM (I). Thus, SUM (I) grows with each "case" total. The resetting of CUM (I) (or "COMMON/ZERO/") and SUM (I) are under analyst control via the "IS" input value.

Prior to printing Figure 20 (after having printed the last Figure 19), the SUM value is placed in the comparable CUM (COMMON/ZERO/) location so the same "WRITE" instructions may be used to print the cost figures for both figures. Thus, definitions and correlations of Roman numerals and mnemonics as shown in Table 5 apply to both Figures 20 and 21.

6.2 Theory of Supply

The LOCAM 5 model incorporates three methods of determining supply quantities and their effects on availability (Section 6.3). They are as follows:

a) Predetermined supply quantities.

b) LOCAM supply rules. These basically incorporate enough supply to stock the supply pipes, the reorder pipe and supplement this with safety stock based on the expected need (using IOL subroutine).

c) MIRADCOM maintenance rules. These rules call for the computation of items tied up in order and shipping time,

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                    COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                     USING LIFE CYCLE COST OF OWNERSHIP AND OPERATICNAL AVAILABILITY AS THE
                      MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                        ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

   ANALYSIS - THREE LRU CLASSES                                                       DATE - JANUARY 2,1977
                                               CASE TOTAL
   COST TOTALS, COST IN THOUSANDS OF DOLLARS                                             RECURRING COSTS
         INSTALLED EQUIPMENT         XXXIII
         TEST EQUIPMENT              XXXIV                                   T.E. MAINTENANCE      XXXV
         TEST EQUIPMENT SPACE        XXXVI                          DEPOT SPACE/UTILITIES      XXXVII
         MAINTENANCE MANPOWER      XXXVIII          FIELD     XXXIX    DEPOT     XL     TOTAL       XLI
                                           TRAINING FIELD      XLII    DEPOT   XLIII    TOTAL      XLIV
         SUPPLY MATERIAL                XLV                                          SUPPLIES      XLVI
         REORCERING                   XLVII                                        REORDERING    XLVIII
         MATERIAL STORAGE              XLIX                                  MATERIAL STORAGE         L
         SUPPLY ADMINISTRATION           LI                              INVENTORY MANAGEMENT       LII
         SHIPPING AND HANDLING          LIII                                         SHIPPING       LIV

         GRAND TOTAL COST                LV                                   TOTAL RECURRING       LVI

         PRESENT VALUE                                                  COST OF INITIAL PROVISION
         DEVELOPMENT                    LVII                                            UNITS     LVIII
         ACQUISITION                     LIX                                          MODULES        LX
         OPERATION AND MAINTENANCE       LXI                                            PARTS      LXII
         END LIFE SALVAGE              LXIII                                  TOTAL PROVISION      LXIV

         GRAND TOTAL                     LXV

   EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

         MAINTENANCE MANPOWER           LXVI
         GRAND TOTAL COST              LXVII
         PRESENT VALUE
         OPERATION AND MAINTENANCE    LXVIII
         GRAND TOTAL                    LXIX          DELTA     LXX              PV DELTA      LXXI
 CAYZ=
CAYZI=
                        MAN-E          DIRECT          GENERAL          DEPOT
HOURS PER DAY
   TEST EQUIPMENT
   REPAIR
NUMBER OF MEN
   TEST EQUIPMENT
   REPAIR
```

Figure 20. Case total output page. (Summary of the data in Figure 19; Roman numerals keyed to Table 5.)

COMPARISON OF FIELD VERSUS DEPOT SUPPORT FCR SELECTED MICOM MISSILE LRUS USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

ANALYSIS - THREE LRU CLASSES — DATE - JANUARY 2,1977

GRAND TOTAL

COST TOTALS, COST IN THOUSANDS OF DOLLARS				RECURRING CCSTS	
INSTALLED EQUIPMENT	XXXIII				
TEST EQUIPMENT	XXXIV			T.E. MAINTENANCE	XXXV
TEST EQUIPMENT SPACE	XXXVI			CEPOT SPACE/UTILITIES	XXXVII
MAINTENANCE MANPOWER	XXXVIII	FIELD	XXXIX	DEPOT XL TOTAL	XLI
		TRAINING FIELD	XLII	DEPOT XLIII TOTAL	XLIV
SUPPLY MATERIAL	XLV			SUPPLIES	XLIV
REORCERING	XLVII			REORDERING	XLVIII
MATERIAL STORAGE	XLIX			MATERIAL STORAGE	L
SUPPLY ADMINISTRATION	LI			INVENTORY MANAGEMENT	LII
SHIPPING AND HANDLING	LIII			SHIPPING	LIV
GRAND TOTAL COST	LV			TOTAL RECURRING	LVI
PRESENT VALUE				COST OF INITIAL PROVISION	
DEVELOPMENT	LVII			UNITS	LVIII
ACQUISITION	LIX			MODULES	LX
OPERATION AND MAINTENANCE	LXI			PARTS	LXII
END LIFE SALVAGE	LXIII			TOTAL PROVISION	LXIV
GRAND TOTAL	LXV				
EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL					
MAINTENANCE MANPOWER	LXVI				
GRAND TOTAL COST	LXVII				
PRESENT VALUE					
OPERATION AND MAINTENANCE	LXVIII				
GRAND TOTAL	LXIX	DELTA	LXX	PV DELTA	LXXI

Figure 21. Grand total. (Summary of data in Figure 20 with noncost factors ignored; Roman numerals keyed to Table 5.)

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TABLE 5. SUMMARY PAGE REFERENCE

Figures 20 and 21 Roman Numerical Reference	Mnemonic COMMON/ ZERO/ Mnemonic	Mnemonic Equivalent in CUM Array	Equation	For information in re items of Equation Refer to	This Item Accumulated for Grand Total in SUM Array (Item No.)	(Cost of)
XXXIII	CCET	CUM(1)	CCET = CCET + CET	CET (Section 6.1.1)	SUM(1)	Installed equipment
XXXIV	CCTS	CUM(2)	CCTS = CCTS + CTST	CTST (Section 6.1.2)	SUM(2)	Test equipment
XXXV	CCTSR	CUM(3)	CCTSR = CCTSR + CTSR	CTSR (Section 6.1.2.3)	SUM(3)	Test equipment maintenance
XXXVI	CCF	CUM(4)	CCF = CCF + CFT	CFT (Section 6.1.3)	SUM(4)	Test T.E. Space
XXXVII	CCF	CUM(4)	CCF = CCF + CFT	CFT (Section 6.1.3)	SUM(4)	Test Depot Space/Utilities
XXXVIII	CCM	CUM(5)	CCM = CCM + CMPT	CMPT (Section 6.1.4)	SUM(5)	Maint Manpower
XXXIX	CCMF	CUM(6)	CCMF = CCMF + α	α*	XUM(6)	Maint Field Manpower
XL	CCMD	CUM(7)	CCMD = CCMD + β	β*	SUM(7)	Maint depot manpower
XLI	CCMFD	CUM(8)	CCMFD = CCMFD + CCMD	CCMFD (XL)	SUM(8)	Total maint Manpower
XLII	CTRF	CUM(9)	CTRF = CTRF + γ	γ*	SUM(9)	Training field
SLII	CTRDEP	CUM(10)	CTRDEP = CTRDEP + δ	δ*	SUM(10)	Training depot
XLIV	CTR	CUM(11)	CTR = CTRDEP + CTR	CTRDEP (XLIII)	XUM(11)	Training total
XLV	CIV	CUM(12)	CIV = CIV + CIVT	CIVT (Section 6.1.5)	SUM(12)	Supply material
XLVI	CIVREC	CUM(13)	CIVREC = CIVREC + CIVR	CIVR (Secion 6.1.5.2)	SUM13)	Supplies
XLVII	CRT	CUM(14)	CRT = XRT + CROT	CROT (Section 6.1.6)	SUM(14)	Reordering
XLVIII	CRT	CUM(14)	CRT = CRT + CROT	CROT (Section 6.1.6)	SUM(14)	Reordering
XLIX and L	XWH	CUM(15)	CWH = CWH + CWHT	CWHT (Section 6.1.7)	SUM(15)	Material Storate
SI	CSA	CUM(16)	CSA = + CSAT	CSAT (Section 6.1.8)	SUM(16)	Supply Administration
SII	CSAREC	CUM(17)	CSARCC = CSAREC + CSAR	CSAR (Section 6.1.8.2)	SUM(17)	Inventory Management
LII & LIV	CSH	CUM(18)	CSH = CSH + CSHT	CSHT (Section 6.1.9)	SUM(18)	Shipping and Handling
LV	CGT	CUM(19)	CGT = CGT + GCT	GCT (Section 6.1.10)	SUM(19)	Grand Total Cost
LVI	CTREC	CUM(20)	XTREC = CCTSR + CCF + CCMFD + CTR + CIVREC + CRT + CWH + CSAREC + CSH	XXXV, XXXVI, XLI	SUM(20)	Total Recurring Cost

*Footnotes for this table are found on page 109.

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TABLE 5. (CONCLUDED)

Figures 20 and 21 Roman Numerical Reference	Mnemonic COMMON/ ZERO/ Mnemonic	Mnemonic Equivalent in CUM Array	Equation	For information in re items of Equation Refer to	This Item Accumulated for Grand Total in SUM Array (Item No.)	(Cost of)
LVII	PCD	CUM(21)	PCD = PCE + PVCD	PVCD (Section 6.1.11.1)	SUM(21)	Present Value Development
LVIII	CQTU	CUM(22)	CQTV = CQTU + CQTT	CQTT (Section 6.1.2.2)	SUM(22)	Initial Units Provision
LIX	PCP	CUM(23)	PCP = PCR + PVCP	PVCP (Section 6.1.11.2)	SUM(23)	PV Acquisition
LX	CQTM	CUM(24)	CQTM = CQTM + CQTMT	CQTMT (Section 6.1.27)	SUM(24)	Initial Modules Processor
LXI	PCR	CUM(25)	PCR = PCR + PVCR	PVCR (Section 6.1.11.9)	SUM(25)	PV of O&M
LXII	CQTP	CUM(26)	CQTP = CPTP + CQTPT	CQTPT (Section 6.1.32)	SUM(26)	Initial Parts Provision
LXIII	PCS	CUM(27)	PCS = PCS + PVCS	PVCS (Section 6.1.11.4)	SUM(27)	PV End Life Salvage
LXIV	CQTUMP	CUM(28)	CQTUMP = CQTU + CQTM + CQTP	LVII, LX, LXII	SUM(28)	Cost of Total Provision
LXV	PCGT	CUM(29)	PCGT = PCGT + PCGCT	PCGCT (Section 6.1.11.5)	SUM(29)	PV of Grand Total Cost
LXVI	SEMPT	CUM(30)	SEMPT = SEMPT + ECMPT	ECMPT (Section 6.1.14)	SUM(30)	Total of Ev. of Personnel
LXVII	SEPC	CUM(31)	SEPC = SEPC + EPCGT	EPCGT = CGT-DELTA CGT (LV) DELTA (Section 6.1.13)	SUM(31)	GCT of Ev.
LXVIII	SPCR	CUM(32)	SPCR = PCR-SPDEL	PCR (LXI) SPDEL (LXXI)	SUM(32)	Present Value(Ev.)
LXIX	SEPV	CUM(33)	SEPV 2 SEPV + EPVGCT	EPVGCT (Section 6.1.16) SEPV (Section 6.1.13)	SUM(33)	Present Value (Ev.) Grand Total
LXX	SDEL	CUM(34)	SDEL = SDEL + DELTA	DELTA (Section 6.1.13)	SUM(34)	Total Difference between integer and Ev Values
LXXI	SPDEL	CUM(35)	SPDEL = SPDEL + PDELTA	PDELTA (Section 6.1.15)	SUM(35)	Present Value of Total Difference between Integer and Ev. Values

*Footnotes for Table 5

No mnemonic has been assigned to the values designated by the Greek alphabetic characters. Rather, they represent expressions as follows:

α: CCMF = CCMF + ((AMULT * YR) * (((DSUM*CDMAN * TDMAN) + (GSUM * CGMAN * TGMAN) + (EACAL * CALSET * CALMAN * TALMAN) + EACSP * CONTCT * CONMAN * TONMAN + (DSUR * CDRMAN * TDRMAN) + (GSUR * CGRMAN * TGRMAN)) - ((168. * ETI * FI) * ((OD * CDMAN* TDMAN * (SAOY/WOM)) + (DI * CGMAN * TGMAN * (SAIY/WIM))))) + CMANE .

In general, each of the preceding terms represents a different aspect of personnel cost. The general format of each element is the product of the number of people (at a particular location) times their individual cost per year. Thus, DSUM (number of Direct Support crews) times TDMAN (effective number of people per crew) times CDMAN ($/year/person) results in a cost per year for Direct Support personnel; similarly the terms containing the following:

1) GSUM represents $/year for General Support personnel.
2) EACAL represents $/year for calibration personnel.
3) EACSP represents $/year for contact support personnel.
4) DSUR represents $/year for Direct Support repair personnel.
5) GSRU represents $/year for General Support repair personnel.

Because these costs (using DSUM and GSUM) include the cost of supporting the test equipment, the next two terms subtract self-support cost of the test equipment. These costs are all summed and converted to AMULT units over YR years. CMANE, the cost of manpower at the equipment is added to provide total field support personnel costs. No depot personnel costs have been included. This cost is accounted for by the following footnote:

β: CCMD is the cost of depot personnel and is formulated as follows:

CCMD = CCMD + ((AMULT * YR) * (((DEPM * TDPMI * CDPMAN) + (DEPAIM * TDPMII * CDPMAN) + (DEPR * TDPRI * CDPRMN) + (DEPAR * TDPRII * CDPRMN))-((168. * CDPMAN * (SADY/WDM)) * ((ETI * FI * (1. -AAIE) * TDPMI) + (ETII * FII * AAIE * TDPMII))))) .

*Footnotes (Continued)

While the preceding is not the exact equation of the program, it is its equivalent reorganized for easier explanation. All elements of the equation deal with personnel at Depot. The main elements follow the format of the product of number of crews (DEPM), equivalent people per crew (TDPMI), and $/year/person. The resulting products represent the following:

1) DEPM, etc. - $/year for Type I test equipment personnel at Depot.

2) DEPAIM, etc. - $/year for Type II test equipment personnel at Depot.

3) DEPR, etc. - $/year for repair people associated with Type I test equipment at Depot.

4) DEPAR, etc. - $/year for repair people associated with Type II test equipment at Depot.

Because the sum of these elements includes effort for self-support of both Type I and Type II test equipment, the work of this self-support is calculated in $/year and subtracted from the sum. The resulting cost/year in $ is converted to AMULT units per year and then to the total for YR years.

γ: CTRF is the accumulation of training costs for field personnel per the equation:

CTRF = CTRF + ((AMULT * YR * CTRA * ARA) * ((TDMAN * DSUM) +

(TGMAN * GSUM) + (EACAL * TALMAN) + (EACSP * TONMAN) + (DSUR *

TDRMAN) + (GSUR * TGRMAN))) .

The last six elements represent the number of people to be trained for the following:

1) Direct Support test equipment.

2) General Support test equipment.

3) Calibration equipment.

4) Contact team.

5) Direct Support repair.

6) General Support repair, respectively.

The sum of these represents the number of people needed at any given moment; multiplication by the following:

*Footnotes (Concluded)

1) ARA allows for the number per annual turnover rate of personnel.

2) CTRA creates $/year.

3) YR creates $ per O&M period.

4) AMULT changes $ to AMULT units.

The result is accumulated under the heading of CTRF. No training for Depot personnel is included.

δ: CTRDEP is the total cost to train personnel associated with the support at Depot. The value of this mnemonic is given by the equation:

CTRDEP = CTRDEP + ((AMULT * CTRA * ARA * YR) * ((TDPMI * DEPM) +

(TDPMII * DEPAIM) + (DEPR * TDPRI) + (DEPAR * TDPRII))) .

This equation is analogous to the previous expression for field training in that the last four terms represent $/year for training people for Type I test equipment operation, Type II test equipment operation, repair operation associated with Type I test equipment, and repair operation associated with Type II test equipment, respectively. Each of these terms represents the product of the number of personnel per crew type (TDPMI) * number of crews of the type (DEPM) = total number of personnel per crew type. These are summed to obtain the total number of depot personnel needed at any one time and then operated on in the same manner as field personnel in the equation for CTRF.

factory response time, repair (turn-around time) and shipping turn-around time. These quantities are integerized and "stocked" at appropriate locations (LRUs, modules, parts at Direct Support, General Support, and Depot).

Selection of the method of determining spares requirements is under the control of the input "AYZP" (Appendix B). If this input is negative, the provision input as QTE, QTO, QTI, QTMO, QTMI, QTMD, QTPO, QTPI, QTPD are the values used as the supply quantities.

These mnemonics may denote values that were input (through the NAMELIST input) or calculated (as described in Section 4). However, until now these quantities were based on a per LRU installation with the LRU in constant use and unaffected by its own inherent availability. At this point, however, the program calculates three multipliers, namely:

SAVE = ED * OTF * AYZ

SAVP = SAVE/D(P)

SAVPP = SAVE/D(PP) .

These three multipliers represent the following:

a) SAVE is the number of LRUs actually on line and operating at any given instant per the inherent availability. Multiplying QTE, QTO, QTI and QTD by SAVE per statements of this type:

   QTE = QTE * SAVE

   translates QTE into a quantity related to the total deployment.

b) Similarly SAVP is a multiplier related to the flow to be expected for each module type within the LRU. Multiplying the values QTMO, QTMI, QTMD by SAVP translates the quantities into numbers related to flow of each module type per statements of the type:

   QTMO = QTMO * SAVP .

c) SAVPP performs the same function as SAVP, but for each part type.

Consequently, as shown in Figure 22, the previously computed (or input) values of QTE through QTPD now refer to the total quantity needed:

a) For all LRUs deployed.

b) For all modules of each module type.

c) For all parts of each part type.

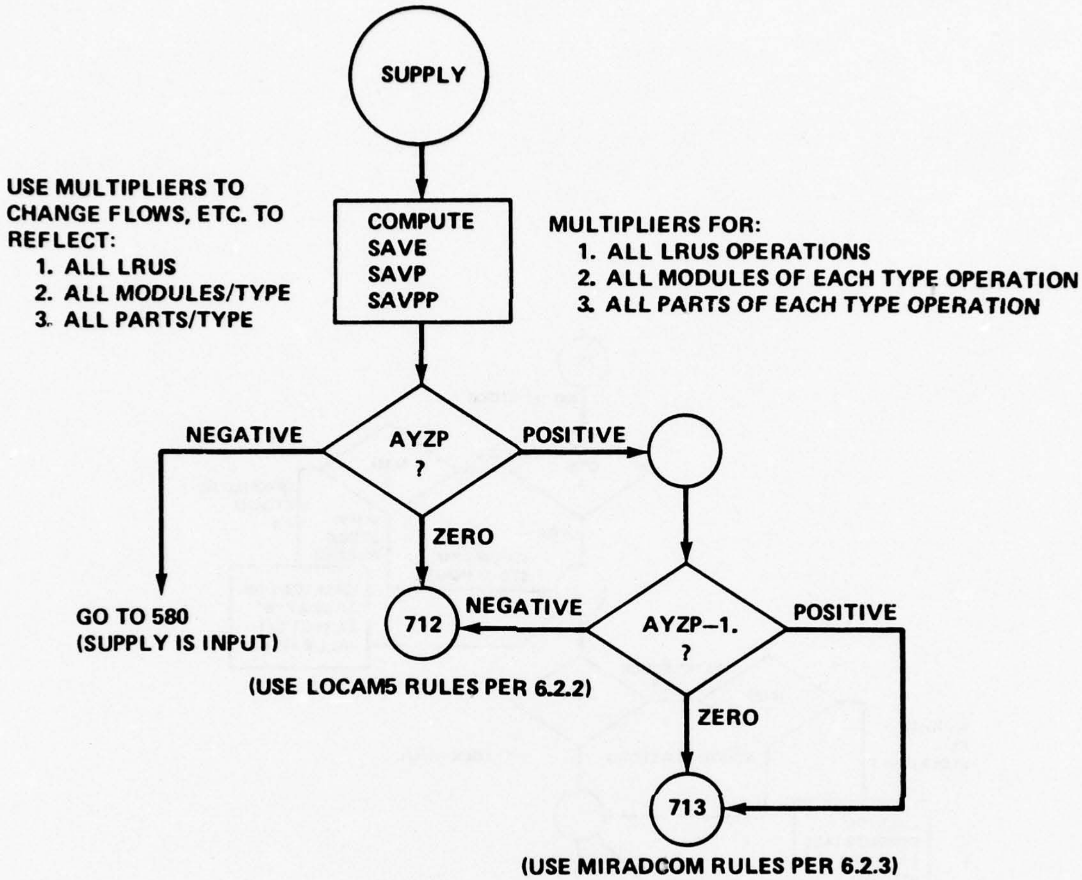


Figure 22. Setting up the supply rules.

Further reference to Figure 22 shows that the value of AYZP is used to select the method of computing supplies.

6.2.1 Predetermined Supply Levels. In this case the analyst inputs the quantity of LRUs (QTE, QTO, QTI, QTD), modules (QTMO, QTMI, QTMD), and parts (QTPO, QTPI, QTPD). The effect that these values have on availability is computed (Section 6.3) and modified if necessary.

6.2.2 LOCAM Supply Rules. As may be seen from Figure 23, there is a pattern to the procedure. For LRUs (the case depicted in Figure 23), QTE is examined first. This represents the modified input value of LRU stock at "E" (equipment) at this point of the program. If its value is

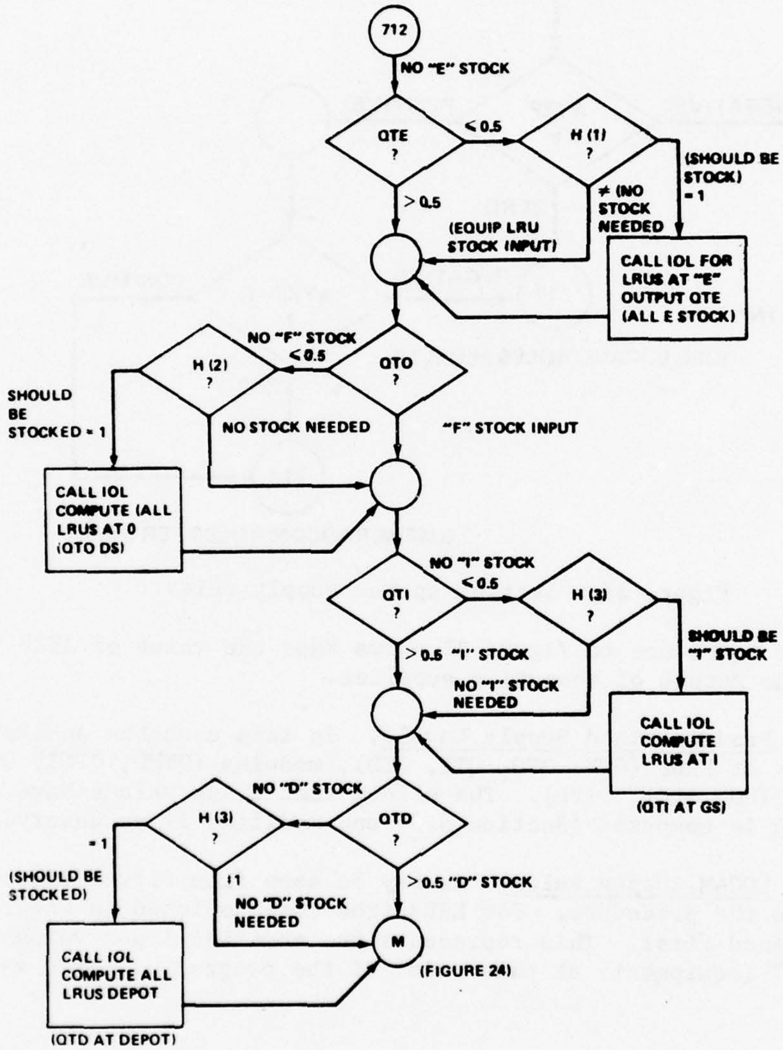


Figure 23. Typical LOCAM LRU stock logic.

> 0.5, it is assumed that the input value is valid and the value is the number of LRUs to be stocked. However, if QTE $\leq$ 0.5, it is assumed that this may not be the actual value wanted. H(1), the "stock at E flat," is examined to determine if stock is intended to be placed at "E" (it is if H(1) = 1). If the answer is yes, the IOL subroutine is called to compute this new QTE value. If no stock is intended to be placed at "E," the QTE value is ignored and in either case the needs for LRU stock at Direct Support, General Support, and Depot are successively explored and, where required, calculated by calling IOL.

6.2.2.1 Module and Part Stock. Module and part requirements are similarly examined and calculated as shown in Figure 24. The logic is similar to that used in the LRU logic, but the "H" flags do not exist for modules and parts and there are only three possible support levels that may stock the modules and parts.

6.2.2.2 IOL Operation. The IOL subroutine is called with the safety stock coefficient (CKK), the number of locations (XD), the quantity tied up in scrap replenishment (BQU), the quantity tied up in float repairs (BQF) (this is zero for parts), and the round-up point (Z) known. As shown in Figure 25, the IOL subroutine adds the two tied-up quantities and multiplies by the number of possible locations (XD). The output (BQT) is set at zero and routine checks on XD and QUF are made for obvious errors [in which case the subroutine returns with the output stock quantity (BQT) at zero].

The safety stock increment (BSQ, the standard deviation from the mean or expected value of stock tied up) is computed as the square root of the mean (per the Poisson distribution).

The amount of safety stock is computed by multiplying the safety stock increment (BSQ) by the coefficient (CKK), an input quantity. This is given the name BQS.

The total stock is computed by adding the pipeline stock (BQU), the repair float stock (BQF), and the safety stock (BQS). It is given the name QUFS and is permitted to have a minimum value of zero.

The total stock (QUFS) is divided by XD to obtain the amount of stock per location, the round-up quantity (Z) is added, and the result is integerized to obtain an integer quantity per location. This integer quantity is multiplied by the number of locations (XD) to obtain total stock quantity of LRUs, modules, or parts. Because of the rounding-up process, the resulting stock quantity always exceeds the expected value of demand for stock.

6.2.3 MIRADCOM Maintenance Rules. As with the LOCAM and predetermined stock quantities, the MIRADCOM stock determination begins with the known QTE through QTPD values. This method of computing the spares is

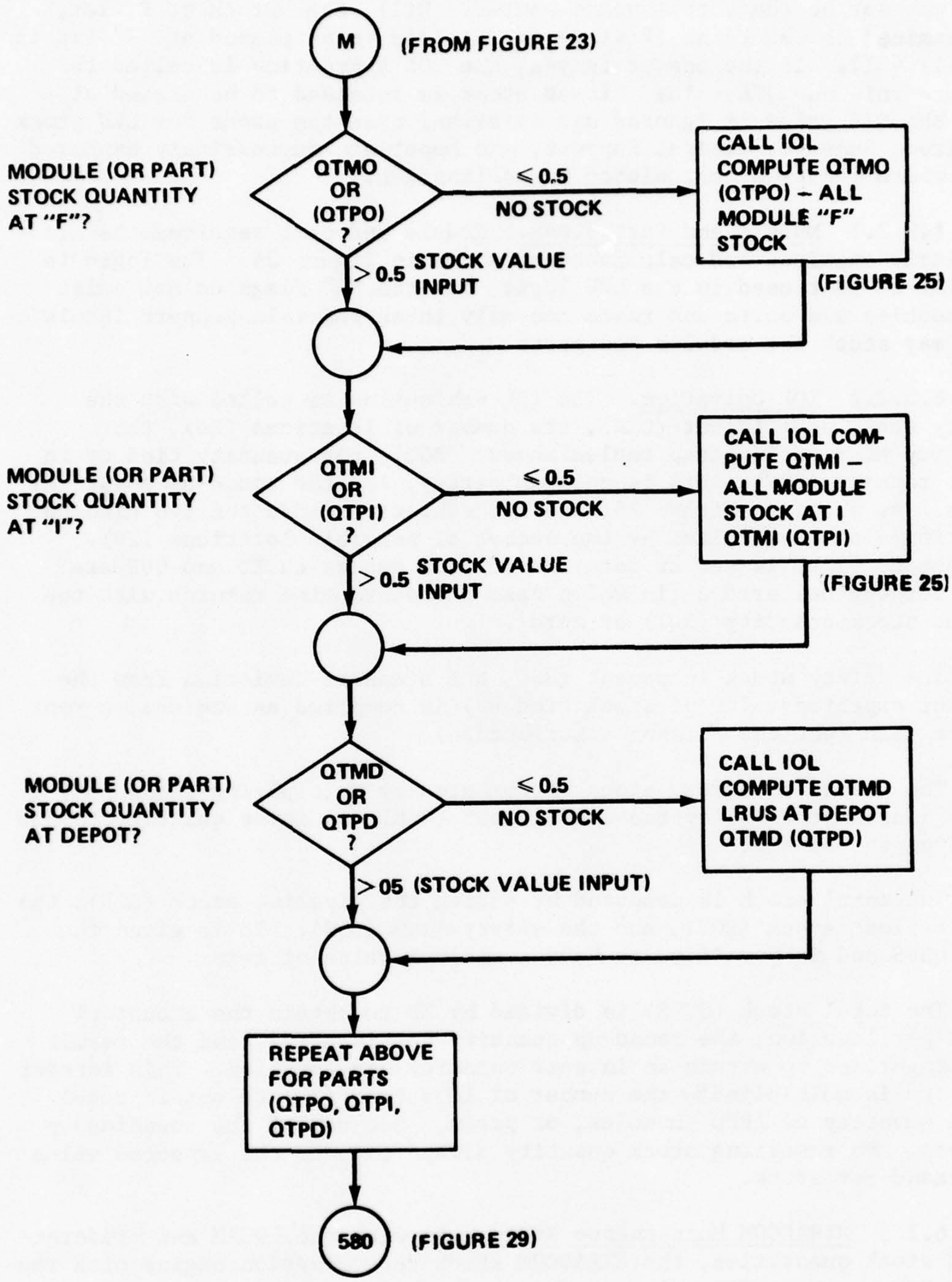


Figure 24. LOCAM Module, part stock logic.

XD	CKK	BQU	BQF	BQT	Z	IOL NAME	
EDS ODS DIS DDS	CKUE CKUO CKUI CKUD	QUE QUO QUI QUD	QFE QFO QFI QFD	QTE QTO QTI QTD	ZU(1) ZU(2) ZU(3) ZU(4)	LRU EQUIV. NAME	NAMES USED IN THE
ODS DIS DDS	CKMO CKMI CKMD	QMO QMI QMD	QFMO QFMI QFMD	QTMO QTMI QTMD	ZM(1) ZM(2) ZM(3)	MODULE EQUIV. EQUIV. NAME	CALLING
ODS DIS DDS	CKPO CKPI CKPD	QPO QPI QPD	0. 0. 0.	QTPO QTPI QTPD	ZP(1) ZP(2) AP(3)	PART EQUIV. NAME	PROGRAM

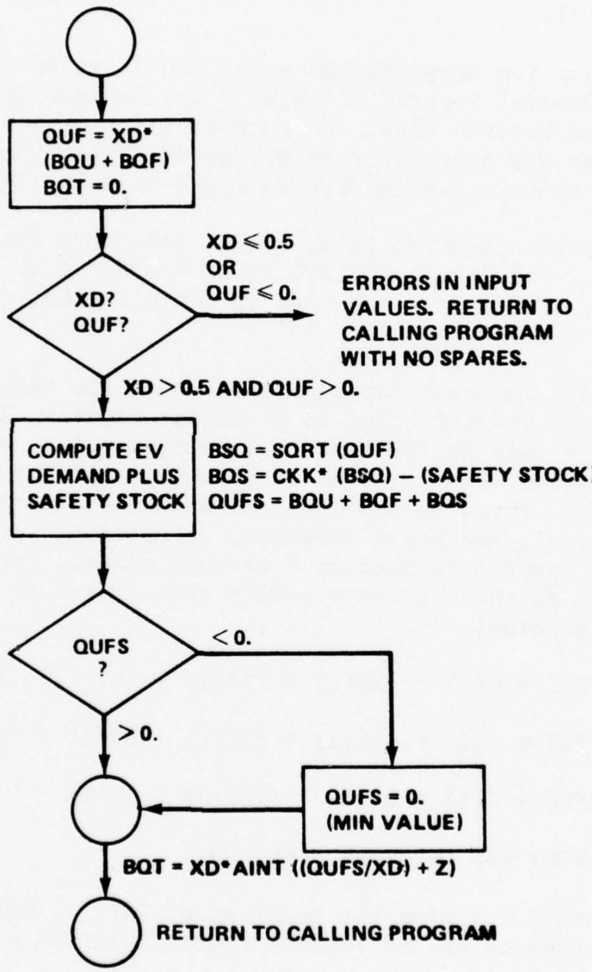


Figure 25. IOL subroutine operation.

used only when AYZP is input as a positive number (its default value = 1). The series of flow charts of the Figures 26 through 28 demonstrate the logic used.

6.2.3.1 LRU Spares.

(A) The need for spares to cover the time to replace scrapped units — QU is computed as the total quantity of scrap units tied up in order and ship time (OST) and (for Depot spares) in the factory response time. First, this quantity is computed on a "per LRU deployed" basis per the equation:

QU = TSU * (OST(1) * H(2) + OST(2) * H(3) + (OST(3) + 7 * FTU) *

H(4))

This equation computes the scrap LRUs tied up in replacement between Direct and General Support (if H(2) ≠ 0), between General and Depot (if H(3) ≠ 0) and between Depot and Factory (if H(4) ≠ 0. This amount is on a per LRU per day basis because OST is in days (Appendix B) and FTU, while input as weeks, is converted to days by multiplying by seven.

QU is then converted to an amount necessary for the entire LRU population by multiplyingby SAVE (= ED * OTF * AYZ) and 24 (hours per day). Thus, QU is the scrap tied up for all LRUs in the replacement cycle (QU = QU * SAVE * 24).

(B) The need for spares to cover the time to repair failed LRUs (the mean quantity tied up in repair float) — The flow through each of the repair facilities for each possible maintenance policy has already been computed in terms of LRUs per facility per hour per deployed LRU. These values were called RO(I), RI(I), and RD(I) for Direct, General, and Depot supports, respectively for maintenance Policy I. This is covered in Section 4 of this manual. Thus, the units tied up in repair at these three possible facilities are as indicated in the following equation:

PUO = PUO + G(I) * (RO(I) * TAT(1) + (RI(I) + RD(I)) * DTO)

PUI = PUI + G(I) * (RI(I) * TAT(2) + RD(I) * DTI)

PUD = PUD + G(I) * RD(I) * (TAT(3) + STAT)

(PUO, PUI, PUD) are initially set = 0.

Appendix B contains the meanings of TAT(I), STAT, DTO and DTI. The preceding computed values represent quantities on a per LRU per hour basis.

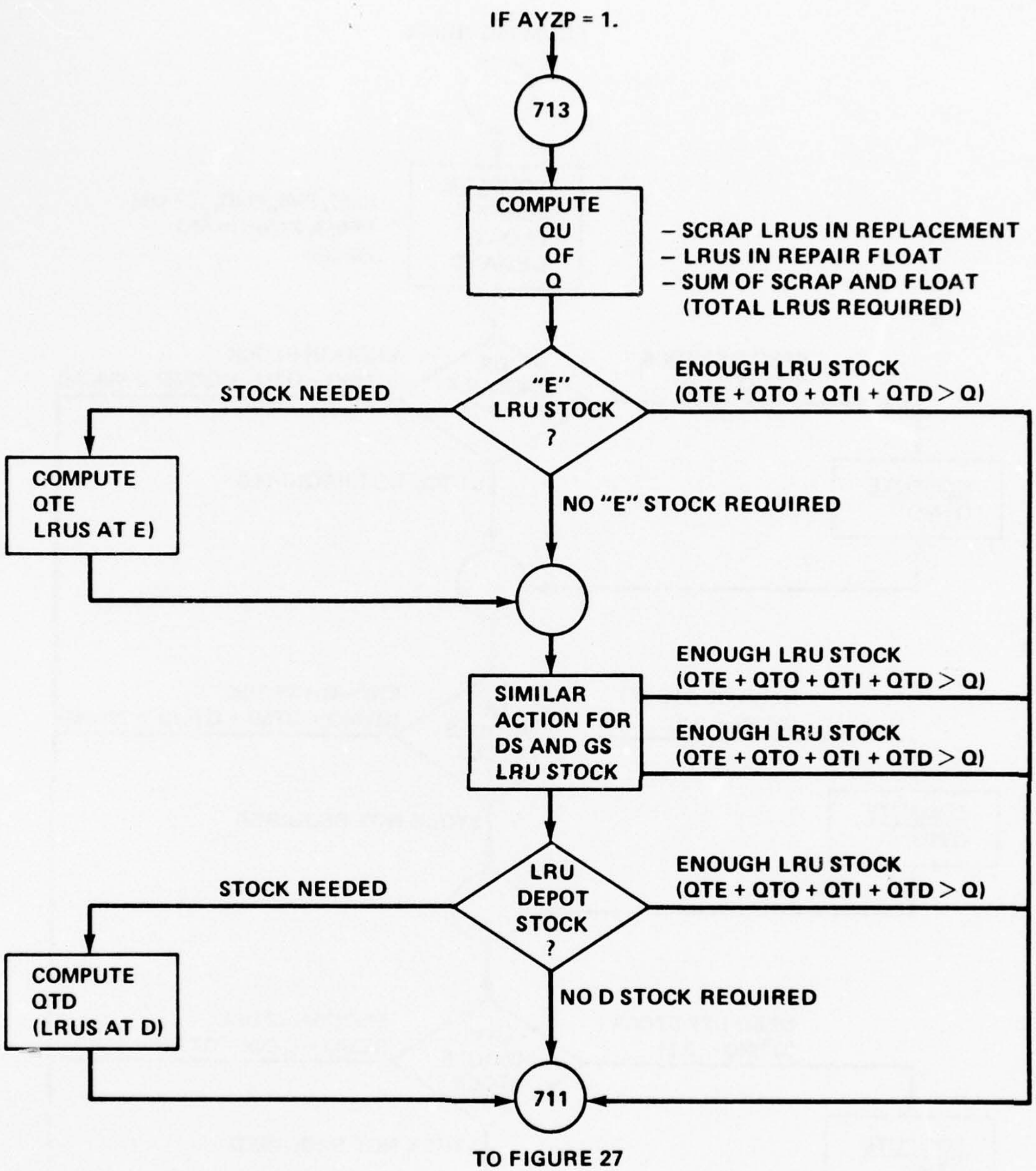


Figure 26. MIRADCOM rules for LRU stock.

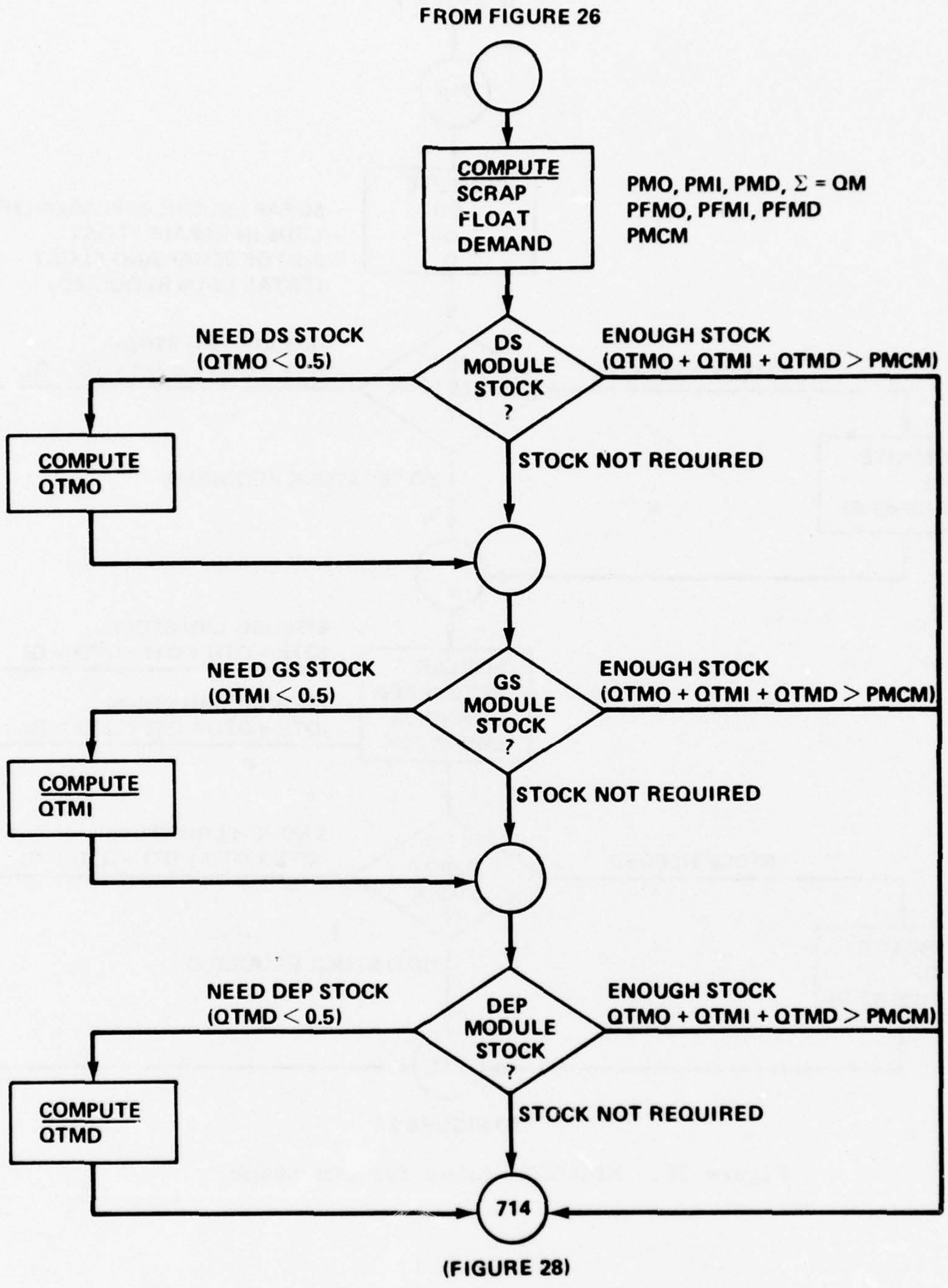


Figure 27. MIRADCOM rules for module stock.

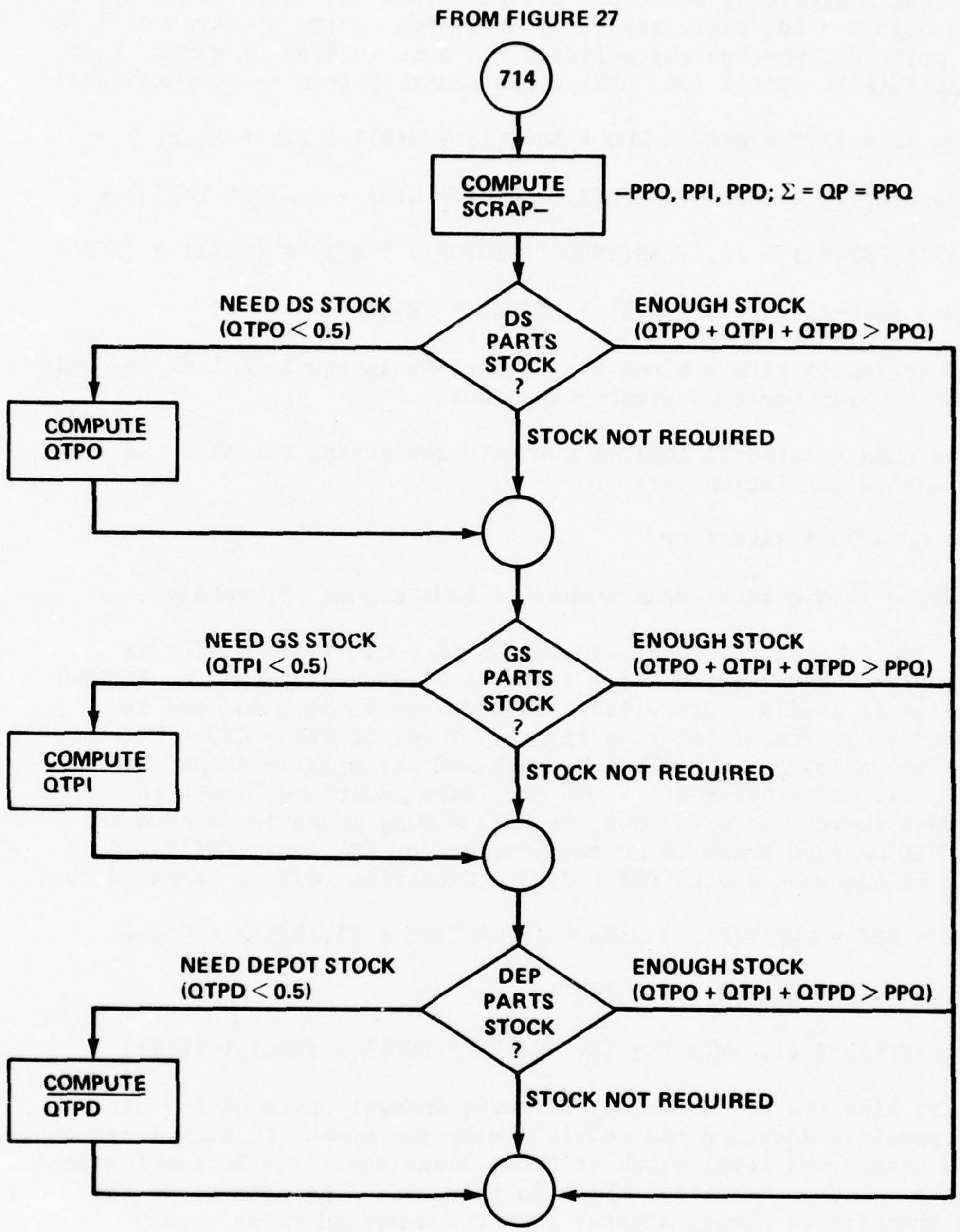


Figure 28. MIRADCOM rules for parts stock.

The three preceding equations are performed for each value of I for I = 1 through I = 20; therefore, they cover the entire spectrum of maintenance policies, whether the policies are pure (= 1.0) or mixed (fractional policies). Total (per LRU) float quantity then is computed per:

QF = TU * TATE * H(I) + PUO * AB(H(1) + H(2)) + PUI * AB(H(1) +

H(2) + H(3)) + TUFD * (AB(H(1) + H(2) + H(3) + H(4)) * TAT(3) +

H(4) * OST(3)) + (1. - AB(TUFOC + TUFOF)) * H(2) * OST(1) * (TRI +

TRD + (1. -AB(TUFI)) * H(3) * OST(2) * TRD.

The AB function is either a one or a zero. It is equal to 1 if the value enclosed in parentheses is greater than zero.

Q is then created to include not only the scrap, but also the float for the entire population per:

Q = QU + 24 * SAVE * QF

Thus, Q is the total mean number of LRUs needed for supply.

(C) Total LRU stock provided (QTE + QTO + QTI + QTD) is checked against that needed (Q) – If it is more than enough, no further computation is needed. Otherwise, the stock to be kept on hand is recomputed (forwardmost location first). Thus, if QTE + QTO + QTI + QTD > Q, there is more than enough stock and the program skips to Statement 711. If QTE + QTO + QTI + QTD $\leq$ Q, some additional stock is needed, but where? If QTE > 0.5, or H(1) < 0.5, there is no need to compute QTE because there is no requirement for "E" stock (H(1) < 0.5) or there is adequate stock (QTE > 0.5). Otherwise, QTE is computed per:

QTE = EDS * AINT ((24. * SAVE * (TU * TATE + (1.-H(2)) * PUO +

(1. -H(2)) * (1. -H(3)) * PUI +

(1. -H(2)) * (1. -H(3)) * (1. -H(4)) * PUD)) / (EDS) + ZU(1))

This, like the LOCAM method, computes integer units of LRU stock at each possible location and multiplies by the number of such locations (EDS) to obtain the total stock at those locations. The integerization requires a round-up quantity (ZU(1) in this case (Appendix B) so the stocked quantity is always greater than the expected value amount.

Further tests are necessary. If (using the newly computed value of QTE), it is found that Q = QTE + QTO + QTI + QTD (or Q-QTO-QTI-QTD = QTE). At this point, the recently computed QTE has just exactly filled the need. However, if QTE > Q-QTO-QTI-QTD, there are more than enough

total spares and there is no need to continue. The program skips to Statement 711 as for the first test. This test is the same test as QTE + QTO + QTI + QTD > Q? except that all but the newly computed QTE values have been transported to the other side of the > sign.

Now QTO is tested (either the input value exceeds 0.5 or the H(2) value indicates that no stock is desired at Direct Support level. Failing this test, a new QTO value is computed per the following corresponding equations or, passing this test, bypasses the QTO computation to the next test. The equations are:

a) Direct Support (0) spares

QTO = ODS * AINT ((24. * SAVE * (PUO + (TSU + (1. -AB (TUFOC + TUFOF)) * (TRI + TRD)) * OST (1) + (1.-H(3)) * PUI + (1. -H(3) * (1. -H(4)) * PUD)) / (ODS) + ZU(2)).

b) General Support (1) spares

QTI = DIS * AINT ((24. * SAVE * (PUI + (TSU + (1. -AB (TUFI)) * TRD) * OST (2) + (1. -H(4)) * PUD)) / (DIS) + ZU(3)).

c) Depot Support (D) spares

QTD = DDS * AINT (24. * SAVE * (TUFD * (TAT(3) + OST(3)) + TSU * (7. * FTU + OST(3)))/ (DDS) + ZU(4)) .

The corresponding tests are:

a) After computing QTO

IF (QTE + QTO.GT.Q-QTI-QTD) Go to 711

(if QTE + QTO > Q-QTI-QTD there are more than enough spares, do not compute QTI or QTD).

b) After computing QTI

IF (QTE + QTO + QTI.GT. Q-QTD) Go to 711

(if QTE + QTO + QTI > Q-QTD there are more than enough spares, do not compute QTD).

c) There is no need for another test after QTD is computed.

6.2.3.2 Module Spares (Figure 27).

(A) The need for spares to cover the time to replace scrapped modules — The scrap flow rate for each module type is described in Section 4. The flow of replacement modules through Direct Support, General Support, and Depots, respectively, is designated as TSMO, TSMI, and TSMD. This flow is in terms of modules of a type per hour per deployed LRU if the LRU operates 100% of the time. The amount of this scrap tied up in order and ship times (OST(1)) and the amount required to be on hand (for OL(1)) operating days and SL(1) safety) is given for the three support locations by the following equations:

PMO = TSMO * (OL(1) + SL(1) + OST(1))

PMI = TSMI * (OL(2) + SL(2) OST(2)) + AB(H(3) + TMFI) * TSMO * OST(2)

PMD = TSMD * (OL(3) + SL(3) + OST(3)) + (TSMO + TSMI) * OTS(3) +

(TSMO + TSMI + TSMD) * 7. * FTM .

(Appendix B contains a definition of input mnemonics).

These individual quantities are summed and multiplied by 24 and SAVP to arrive at the actual total quantity for each type of module by the equation:

QM = 24. * SAVP * (PMO + PMI + PMD)

which, by substitution, is:

QM = 24. * ((ED * OTF * AYZ)/D(P)) * (PMO + PMI + PMD) .

(B) The need for spare modules to cover the repair time (otherwise known as repair float quantity) for the three support areas is given by:

1) Direct Support

PFMO = (F * SMOC) * ((GL * FMO * AB(TUMO)) + (FUO +

((GM * BBMI) + (GN * BBMD)))) * TAT(1).

(Only policies GL, GM, and GN repair modules at Direct Support)

2) General Support

PFMI = F * (SMIC * FMI * ((GM * BO) + (SUOC * GO) +

GR)) * AB (TUMI) * TAT(2) + (F * BBMD/DAOQL) *

((SMOC * FUO * GN * AB(TSMI)) + (SUOC * GP * FUI) +

(GS * FUI)) * TAT(2) + (F * ((GN * BMO) + (GS * BMI)) +

FCOC * GP * BMI) * TAT(2).

3) Depot Support

PFMD = QFMD * AB(TUMD(* TAT(3) / (TUMD + 1. -AB(TUMD)) +

(F * BBMD * ((SMOC * FUO * GN) + (GP * FUI) + (GS * FUI)) /

DAOQL) * (TAT(3) + OST(3)) + (F * ((GN * BMO) +

(GS * BMI)) + FCOC * GP * BMI) * TAT(3).

(C) Total module spares demand — This quantity is given by the sum of the scrap quantities (A). However, because these [as computed in (A) and (B)] are on a per LRU per hour basis (with LRUs operating full time), this quantity must be multiplied by (24 * SAVE/(P)) to obtain actual quantities, namely:

PMCM = (PMO + PMI + PMD + PFMO + PFMI + PFMD) * 24. * SAVE / (P)

As with the LRUs, the module stock at each support level (as computed to date) must be compared with the computed requirement to determine whether the current stock quantity is adequate or if a new value must be computed. The total stock is tested first; then the forwardmost stock is computed if needed. The new total stock (including the just computed stock) is tested for adequacy before generating new values for the next rearward level of support or skipping that level (or all levels). The stock for each level is given by the following equations:

a) Direct Support

QTMO = ODS * AINT (24. * SAVE / (P) * (PMO + PFMO) / (ODS)

+ ZM(1) .

b) General Support

QTMI = DIS * AINT (24. * SAVE / (P) * (PMI + PFMI) / (DIS)

+ ZM(2)) .

c) Depot Support

QTMD = DDS * AINT (24. * SAVE / (P) * (PMD + PFMD) / (DDS)

+ ZM(3)).

Again the quantities are integerized before multiplying by the number of sites so that the final sum of QTMO + QTMI + QTMD must exceed the expected value of demand.

d) The decision to compute QTMO, QTMI and QTMD is made only *if:*

1) For QTMO:

$$QTMO + QTMI + QTMD \leq PMCM$$

and

$$QTMO \leq 0.5 \text{ (not adequate stock) .}$$

2) For QTMI:

$$QTMO + QTMI + QTMD \leq PMCM$$

and

$$QTMI \leq 0.5 \text{ (not adequate stock) .}$$

3) For QTMD:

$$QTMO + QTMI + QTMD \leq PMCM$$

and

$$QTMD \leq 0.5 \text{ (not adequate stock) .}$$

Completion of module stock computation results in the arrival of the program at Statement 714, the start of part stock computation.

6.2.3.3 Parts Spares (Figure 28). Parts are, by definition, irrepairable. Therefore, the only spares required are those required to last through the specified days of supply (OL), the safety stock time (SL), the order and ship time (OST), and factory response time (for Depot only). This is based on the previously computed (Section 4) flow rates.

(A) *The need for spare parts to cover the time to replace the* scrapped parts — For each of the three support areas (Direct, General, and Depot), these needs are expressed respectively by the following equations:

PPO = TSPO * (OL (1) + SL(1) + OST (1))

PPI = TSPI * (OL(2) + SL(2) + OST(2)) + AB(H(3) + TSPI) * TSPO * OST(2)

PPD = TSPD * (OL(3) + SL(3) + OST(3)) + (TSPO + TSPI) * OST(3) +

(TPSO + TSPI + TSPD) * 7. * FTP

(Appendix B contains the meaning of input mnemonics).

Each of the preceding equations computes a quantity of parts tied up based on the flow in parts per hour per deployed LRU.

(B) The total expected value quantity is the sum of the three items above multiplied by 24 (hours per day) and SAVPP (to account for the possibility that the LRU may not operate 24 hours a day (due to scheduled or unscheduled "off" time) and the total LRUs deployed). The program gives this quantity two names, computing them in two separate but functionally identical equations, namely:

QP = 24. * SAVPP * (PPO + PPI + PPD) and

PPQ = (PPO + PPI + PPD) * 24. * SAVE / (PP).

Since SAVPP = SAVE / (PP), the equations are identical.

As with the LRUs and the module stock, the parts stock at each support level (as computed to date) must be compared with the computed requirement to determine whether the current stock quantity is adequate or if a new value must be computed. The total stock is tested first; then the forward-most stock quantity is computed (if needed). The new total stock (including the just computed stock) is tested for adequacy before generating new values for the next rearward level of support or skipping that level (or all levels). The stock for each level is given by the following equations:

1) Direct Support

QTPO = ODS * AINT (24. * SAVE / (PP) * PPO / (ODS) + ZP(1)).

2) General Support

QTPI = DIS * AINT (24. * SAVE / (PP) * PPI / (DIS) + ZP(2)).

3) Depot Support

QTPD = DDS * AINT (24. * SAVE / (PP) * PPD / (DDS) + ZP(3)).

Again, the quantities are intergerized prior to multiplying by the number of support locations so the final sum of QTPO + QTPI + QTPD must exceed the expected value of demand.

4) Tests: The decision to compute QTPO, QTPI, and QTPD is made only if:

a) For QTPO:

(QTPO + QTPI + QTPD) $\leq$ PPQ and QTPD $\leq$ 0.5 (not adequate stock).

b) For QTPI:

(QTPO + QTPI + QTPD) $\leq$ PPQ and QTPI $\leq$ 0.5 (not adequate stock).

c) For QTPD:

(QTPO + QTPI + QTPD) $\leq$ PPQ and QTPD $\leq$ 0.5 (not adequate stock).

Completion of parts stock (MIRADCOM) computation results in the arrival of the program at Statement 580, the end of stock computation.

6.2.4 Terms Representing Summations of Spares and Demand. The following list summarizes spares and demand:

a) The stock LRUs are summed separately as QT.

b) The stock modules are summed separately as QTM.

c) The stock parts are summed separately as QTP.

d) The total expected value LRU demand is summed as RQU.

e) The total expected value module demand is summed as RQM.

f) The total expected value part demand is summed as RQP.

g) OR is set to = 1 within the program only if LOCAM rules for stock are used.

The program is now ready to consider the effect of stock level on availability.

6.3 Availability

As used in the LOCAM 5 model, the availability equations, while stated in terms of the number of LRUs "down" or inoperative, are actually based on the classical definition contained in the following paragraph.

6.3.1 Classical Definition. AYZ = MTBF/(MTBF + MTTR) wherein MTBF is the meantime between failures, MTTR is the meantime to repair the LRU and AYZ is availability. If both MTBF and MTTR are stated in the same units of time, the fraction is dimensionless. It is, in fact, the fraction of total time that the LRU is operable.

6.3.2 Substitution for LOCAM 5. In LOCAM 5, the following substitutions have been made in the equation of Section 6.3.1:

1/F' = MTBF

T = MTTR,

then

AYZ = 1/F' / (1/F' + T)

AYZ = 1/(1 + F'T) .

Actually, T is complex. It involves the time to realize that a failure has occurred, the time to identify the failed component, the time to acquire the replacement, the time to install the replacement, the time to test the LRU, and the time to get the LRU back into service. This is further complicated by the existence of four possible levels of support. T does represent time, however, and T * F' represents a quantity (the product of quantity per unit time and time).

If, for F' the expression A + F + FNG is substituted (in Section 4, A is attrition or (YAT/8766) * EE; F is E * EE and FNG = FNGF * E * EE), then to be consistent, all other terms of the equation must be multiplied by EE, too. The equation then becomes:

AYZ = EE/(EE + (A + F + FNG) * T).

6.3.3 Inherent Availability. Substituting again, it is recalled that A + F + FNG is the rate of LRU removals if the LRUs are on line 100% of the time. If the LRUs are on line OTF of the time, then OTF * (A + F + FNG) removals take place and the equation becomes:

AYZ = EE/(EE + (A + F + FNG) * T * OTF).

As pointed out previously, the product (A + F + FNG) * T is a quantity (the quantity "down" at any given instant) and QYZ may be substituted for it. Thus:

AYZ = EE/(EE + QYZ * OTF).

This is the basic availability equation used in LOCAM 5 to compute the inherent availability of the LRU. The result is modified by the SPOL

subroutine to account for allowable failures (FN in Appendix B). The value is retained as CAYZI(I) (if TAYZ(I) = 1 in which (I) may have a value of 1 through NA (Appendix B). CAYZI represents system availability. This availability is "inherent availability." That is, it is the highest possible value because the spares are assumed to be available for every need.

6.3.4 Operational Availability. Spare quantities of LRUs modules and parts at the various support levels are determined as noted in Section 6.2. These spares may or may not be enough to meet the demand.

6.3.4.1 LRU Demand. The demand for spare LRUs is computed as the sum of the "down" LRUs due to pipeline delays and repair delays and designated as RQU (Section 6.2.4).

6.3.4.2 Module Demand. The demand for spare modules is also the sum of the modules "down" in the pipelines and awaiting repair. This is designated as RQM and is the demand for a particular module type (Section 6.2.4).

6.3.4.3 Part Demand. The demand for parts is also the sum of parts "down" as noted in the supply Section 6.2. RQP has been designated as the sum of the down parts in Section 6.2.4.

6.3.4.4 DEF Function (for Back Order Quantity (BOQ)). This (BOQ) is a term widely used by warehouse people to designate unfilled orders for items from the warehouse. The unfilled orders result from an inadequate supply for meeting the demand experienced during any given interval between resupplies.

In the model, the back ordered quantities are computed by the function DEF. This function is based on a Poisson distribution of demand per resupply interval. At the high end of the distribution, there are some intervals during which demand exceeds the supply. No matter how much stock is kept on hand, there is always some probability that there will not be enough stock to meet the demand. As the amount of stock increases, this probability approaches (but never reaches) zero.

On the other hand, it can be shown mathematically that if only the average demand is stocked, the unfilled orders will amount to less than 10% of the demand. In Section 6.2, it was stated that because of stocking integer quantities, the stock always exceeds the expected value of demand thereby reducing the probability of not having enough stock still further. However, the probability does exist and it must be considered in the computation of operational availability.

The function DEF is called with the expected value demand (RQU for example), the stock on hand (QTE, for one), and unity for the third input (which the function uses internally as a divider and multiplier; therefore, it has no effect on the outcome).

A typical call might be BOQ = DEF(RQU, QTE, 1) which would cause the function to compute the average number of unfilled orders at a warehouse stocking QTE units at the beginning of each resupply interval and experiencing an average demand for RQU units during that interval. The call used in the program is not that simple. Rather, the call is:

QYU = DEF(RQU + P * DEF *RQM + PP * DEF (RQP, QTP, 1.) / D(P),

QTM,1.), QT, 1.) / SAVE.

This is a deceptively complex call, nesting in turn three calls: one call each on parts, modules, and LRUs. The first call calculates the shortage of parts (DEF(RQP, QTP, 1), multiplies this by the number of part types (PP), and divides by the number of module types to determine how the shortage of part types will affect the demand on each type of module. The shortage of modules increases the demand for modules on the next call (DEF(RQM + PP --------, QTM, 1)). The shortage of modules (if any) in turn increases the demand for LRUs in the final call DEF(RQU + P * DEF -----), QT, 1) to determine the final effect on all LRUs. Dividing by SAVE converts the results to the shortage of LRUs at a single (typical) location.

6.3.4.5 <u>Generation of Operational Availability</u>. As noted in Section 6.3.4.4 (Paragraph 3), Operational Availability is availability as affected by supply. The equation used remains the same as in Section 6.3.3 except that the quantity down must be increased by the quantity of LRUs for which no spares can be found (BOQ per Section 6.3.4.4). Thus the equation of Section 6.3.3:

AYZ = EE/(EE + QYZ * OTF)

becomes

AYZ = EE/(EE + OTF * (QYZ + QYU))

in which QYU is the BOQ of Section 6.3.4.4.

Referring to the flow chart of Figure 29, it is noted that:

(A) <u>AYZ</u> - The quantity QYU is determined as discussed in 6.3.4.4. AYZ is calculated as previously. It is then modified by the SPOL function to account for redundant equipment or built-in spares (permitting multiple failures before an LRU is considered failed) and renamed AYZOS.

(B) <u>AYZOS</u> - If the value of AYZOS meets the desired goal or if the spares are the result of predetermined (input) quantities and not calculated by either of the two methods, the program skips to Statement 993. The operational availability is complete. This is accomplished by the program statement:

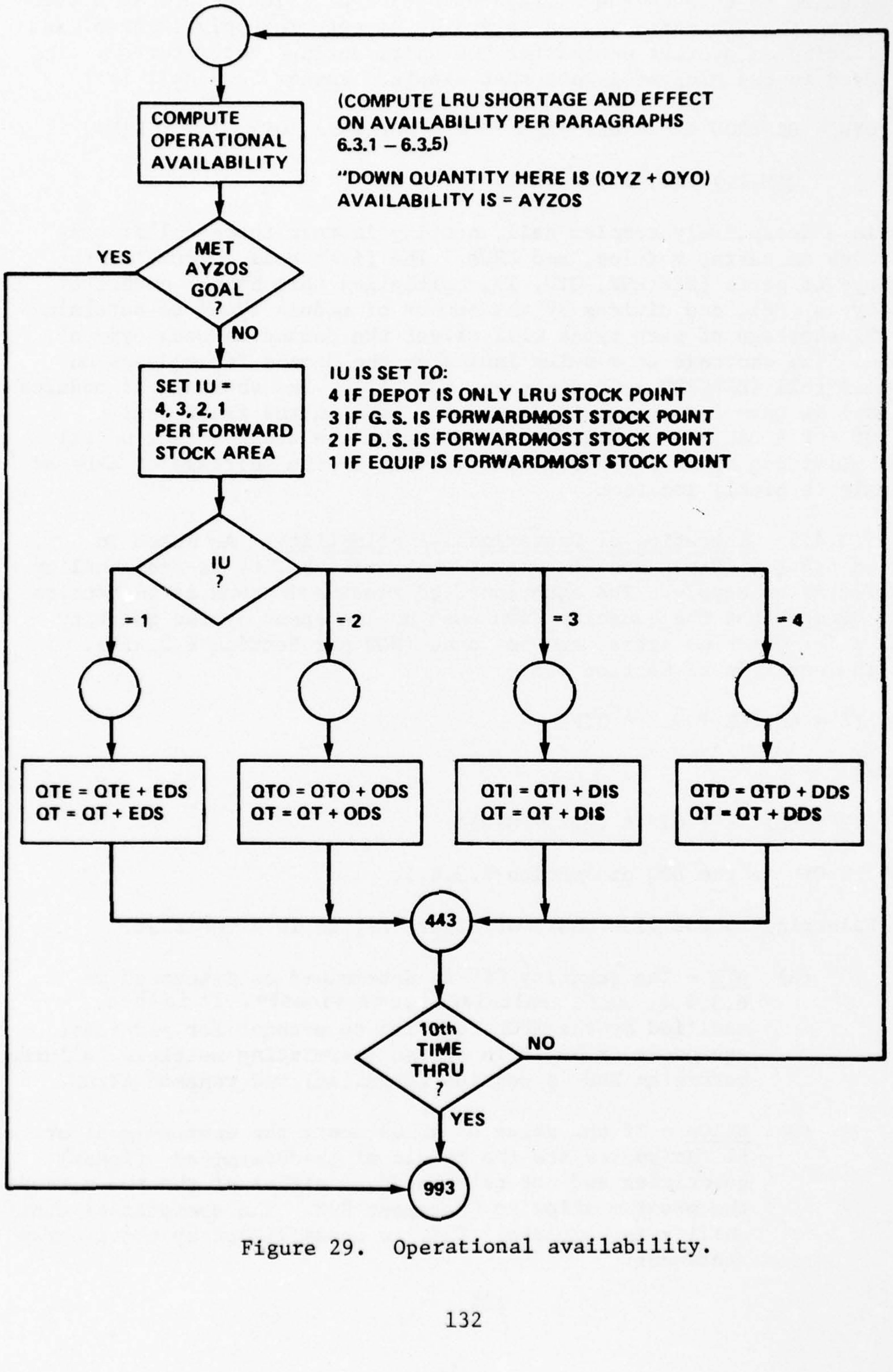


Figure 29. Operational availability.

IF (AYZOS.GT.1.+ OR ** (1./EE * REPEAT)) * (AYZIS-1.).OR.OR.LT

..5) Go to 993.

However, if the availability goal is not met further, spares must be added, but where?

(C) IU is set to equal 4, 3, 2, or 1 depending upon whether the forwardmost LRU spares are to be found at Depot, General Support, Direct Support, or Equipment. Examination of IU determines which set of equations to use and one LRU is added per location. The total LRU spares, QT, is increased by the same amount and the process beginning with (A) is repeated until (B) is satisfied or 10 loops have been performed.

(D) CAYZ(I) may have as many as 10 (specified by the value of NA) availabilities stored according to the statement:

IF(TAYZ (I) .EQ.1.) CAYZ (I) = CAYZ(I) * (AYZOS ** REPEAT)

in which I ranges from 1 through NA, and for every value of I for which TAYZ (I) = 1 the new value of CAYZ (I) is computed.

6.3.5 Redefining Supply Quantities. The original supply quantities (Section 6.2) are based on the multipliers SAVE, SAVP, SAVPP as defined in Section 6.2. These multipliers, in turn, are based on the availability then in effect (inherent availability, AYZ). In Section 6.3.4.5, the operational availability of the LRU was obtained and new multipliers (or redefined values for old multipliers) must be obtained, namely:

SAVE = ED * OTF * AYZ

SAVP = SAVE/D(P)

SAVPP = SAVE/D(PP)

SAVEOB = SAVE/D(OD)

SAVEIB + SAVE/D(DI)

SAVEDB = SAVE/D(DD) .

The first three of these are the same multipliers as in Section 6.2, but slightly modified by the new value of AYZ. SAVEOB, SAVEIB, and SAVEDB are new, however, and represent the effective number of installations supported by the Direct, General, and Depot support facilities, respectively.

6.3.5.1 Scrap Modifications. The scrap rates on which the original supply quantities are based are TSU, TSMO, TSMI, TSMD, etc. (Section 6.2.3.1, for example). These must now be revised and given new names:

SUT = SAVE * TSU

TSM = TSMO + TSMI + TSMD

SMT = SAVP * TSM

TSP = TSPO + TSPI + TSPD

SPT = SAVPP * TSP.

6.3.5.2 LRUs, Modules and Parts Tied Up Due to HPU, HPM, and HPP:

QUDH = QUDH * SAVE

QMDH = QMDH * SAVP

QPDH = QPDH * SAVPP

The preceding equations were originally defined by subroutine BASIC.

6.3.5.3 Total "Ontime." Other multipliers developed include the following:

YR8 = 8766 * YR (the length of support time in hours)

ONTIME = YR8 *SAVE LRU hours "on" over YR years.

6.3.5.4 New Stock Quantities:

Depot = QTD = QTD + AINT(QUDH).

Total LRUs = QT = QTE + QTO + QTI + QTD (any of which may have changed from the values computed in 6.2 as noted in 6.3.4.5).

SECTION 7
SENSITIVITY TESTING

When a tray of cards punched with a set of input data has been run as a baseline case, it is often desirable to be able to rerun the entire tray with selected changes in certain of the input variables. To facilitate this, the program writes a copy of the input data to a memory device during the baseline run. Subsequently, these data may be retrieved, edited, and rerun. These reruns of the input tray based on selected editing are referred to as sensitivity runs.

7.1 Sensitivity Input Array

One of the elements of the input NAMELIST/L/ is an array named SENSY. Values input to this array are used to direct the conduct of sensitivity runs. The array SENSY, stored in common block SENS, has Dimension 266. Entries into these 266 storage locations perform the following functions:

a) Specify the number of input variables whose values are to be edited during the sensitivity runs.

b) Specify the number of times the inputs are to have their values edited. (This specifies the number of sensitivity runs).

c) Specify the rulesto be used for the editing of each designated input.

d) Designate the inputs to be altered.

e) Furnish the numeric values to be used by the specified rules in the edition of the designated inputs.

7.1.1 First Element of the SENSY Array. In more detail, the first element of SENSY, i.e., SENSY(1), is used to accomplish Function (a) in Section 7.1. A positive, real, whole number is entered to state the number of inputs being tested. Within the program, this is called MODE. This program is currently written so that MODE may range from one to twelve inputs. Most than twelve inputs results in an error message:

BAD SENSY

followed by a printout of the contents of array SENSY, the sensitivity test is abandoned, and the program resumes as though it were a new start after completing sensitivity testing.

The exact value 0 is used to denote that sensitivity testing is off and the program is running baseline cases. This value exists at program start by initialization in a BLOCK DATA subprogram. Thus, SENSY need not be input to run the baseline case. Similarly, after the completion

of all the work of a sensitivity run, SENSY(1) is reset to zero and no input is needed to resume analysis of baseline cases. In fact, all elements of SENSY are reset to zero. (Input of negative values in SENSY(1) are not detected by the program. The program will run SENSY with unpredictable results. Negative values should not be entered for SENSY(1).

7.1.2 Second Element of the SENSY Array. The second element of SENSY, i.e., SENSY(2), is used to carry out Function (b) given in Section 7.1. A positive, real, whole number is entered to stipulate the number of sensitivity runs. This is known as NPASS within the program. Due to the limitations of the dimensionality of SENSY, there is a limit to the number of passes that can be made by one loading of SENSY. The number depends on MODE. Table 6 lists the limits on NPASS for the twelve possible values of MODE.

TABLE 6. LIMITS ON SENSY (2)

MODE	NPASS LIMIT
1	262
2	130
3	86
4	64
5	50
6	42
7	35
8	31
9	27
10	24
11	22
12	20

The remaining elements of SENSY are furnished as ordered sets of size MODE. Thus, if only one input is being tested, the set size is one; if two, the size is two, etc. up to the limit of twelve per set when MODE is 12.

7.1.3 Third Element of the SENSY Array. Function (c) in Section 7.1 is the specification of the edited rules. This is accomplished by furnishing a set of positive, real, whole numbers. There is one rule number in the set for each of the MODE variables to be varied. The permissible rule numbers are as follows:

Rule Number	Effect
1.	Assign
2.	Add
3.	Subtract
4.	Multiply
5.	Divide

If any other value is used, an error message will be written as follows:

ILLEGAL RULE KRULE = X

giving the sequence of the rule. That input will not be altered and the program will continue. Later sets of entries in SENSY contain values to be used with these rules. Thus, for Rule 1, the value furnished is used instead of the value in the baseline data. Rules 2, 3, 4, and 5 take the value given in SENSY and combine it with the baseline value to obtain a new value using addition, subtraction, multiplication, or division as specified.

Within the program, the set of rules is stored in array NRULE, of Dimension 12. Should Rule 5 ever encounter the value zero in SENSY, the error message

ATTEMPTED DIVIDE ERROR INDEX = X

will be written where X will be the sequence number in the SENSY array. The program will continue using the baseline value for that variable.

Thus, with MODE in SENSY(1), NPASS in SENSY(2), the set of MODE rules are entered in SENSY(3) to SENSY (MODE + 2).

7.1.4 Designation of the Variables to be Tested. In the designation of the variables for sensitivity testing, the program is structured to reference them by their numbered positional location in common block INPUT rather than by name. The numbered sequence for addressing LOCAM 5 inputs to be sensitivity tested is given in Table 7. The listing shown is alphabetically and numerically sequenced for LOCAM 5 except for three inputs at the end which are not in previous versions of LOCAM. Thus, to refer to input E, the LRU failure rate, the number to be entered in SENSY is 76. The reference numbers are to be entered as positive real whole numbers. Should a value other than those in the table be entered, an error message will be entered as follows:

ILLEGAL VARIABLE ADDRESSED = M

where M is the illegal number. The program will continue and no variable will be altered for that bad value.

TABLE 7. ALPHABETICAL LISTING OF INPUTS ADDRESSABLE BY SENSY (Giving FORTRAN Name of Input and Corresponding SENSY Designation Number)

ARA	1	CONTCT	46	FINT	91	SMF	136	TOE	181	TAT(3)	226
AYZP	2	CPE	47	FMD	92	SMI	137	TOI	182	TAYZ(1)	227
CAD	3	CPI	48	FMI	93	SMO	138	TOMW	183	TAYZ(2)	228
CALMAN	4	CPII	49	FMO	94	SPE	139	TONMAN	184	TAYZ(3)	229
CALPUB	5	CPP	50	FN	95	SPEV	140	TRC	185	TAYZ(4)	230
CALSET	6	CPUBII	51	FNGF	96	SPEVR	141	TUMD	186	TAYZ(5)	231
CCAL	7	CRI	52	FNSP	97	SUD	142	TUMI	187	TAYZ(6)	232
CCALP	8	CRII	53	FSA	98	SUI	143	TUMO	188	TAYZ(7)	233
CCALR	9	CRM	54	FTI	99	SUO	144	WD	189	TAYZ(8)	234
CCSP	10	CRP	55	FTII	100	SVE	145	WDM	190	TAYZ(9)	235
CCSPP	11	CRU	56	FTM	101	SVR	146	WDR	191	TAYZ(10)	236
CCSPR	12	CSDEP	57	FTP	102	SVT	147	WI	192	ZM(1)	237
CDDI	13	CSDSU	58	FTU	103	SVV	148	WIM	193	ZM(2)	238
CDEO	14	CSGSU	59	FUD	104	TALMAN	149	WIR	194	ZM(3)	239
CDFD	15	CTCPUB	60	FUI	105	TATE	150	WM	195	ZP(1)	240
CDID	16	CTRA	61	FUO	106	TC	151	WO	196	ZP(2)	241
CDIO	17	CTRCAL	62	HPM	107	TD	152	WOM	197	ZP(3)	242
CDMAN	18	CTRI	63	HPP	108	TDI	153	WOR	198	ZU(1)	243
CDOE	19	CTRII	64	HPU	109	TDMAN	154	WP	199	ZU(2)	244
CDOI	20	CTRSPT	65	OD	110	TDMW	155	WTKIT	200	ZU(3)	245
CDPMAN	21	CUBEM	66	ODS	111	TDPMI	156	WU	201	ZU(4)	246
CDPRMN	22	CUBEP	67	OTF	112	TDMPII	157	YAT	202	STAT	247
CDRMAN	23	CUBEU	68	P	113	TDPRI	158	YD	203	DTO	248
CEN	24	CUCE	69	PMR	114	TDPRII	159	YMWO	204	DTI	249
CEND	25	CUP	70	PP	115	TDR	160	YP	205		
CFTD	26	DAOQL	71	PPR	116	TDRMAN	161	YR	206		
CGMAN	27	DD	72	PUR	117	TEO	162	YZ	207		
CGRMAN	28	DDS	73	QMM	118	TF	163	ZFL	208		
CI	29	DI	74	QMP	119	TFR	164	ZI	209		
CII	30	DIS	75	QMU	120	TGMAN	165	ZO	210		
CKIT	31	E	76	QTD	121	TGRMAN	166	H(1)	211		
CKMD	32	ED	77	QTE	122	TI	167	H(2)	212		
CKMI	33	EDS	78	QTI	123	TID	168	H(3)	213		
CKMO	34	EE	79	QTMD	124	TIMW	169	H(4)	214		
CKPD	35	EVDM	80	QTMI	125	TIO	170	OL(1)	215		
CKPI	36	EVDR	81	QTMO	126	TIR	171	OL(2)	216		
CKPO	37	EVDT	82	QTO	127	TMD	172	OL(3)	217		
CKUD	38	EVIM	83	QTPD	128	TMDD	173	OST(1)	218		
CKUE	39	EVIR	84	QTPI	129	TMDR	174	OST(2)	219		
CKUI	40	EVIT	85	QTPO	130	TMI	175	OST(3)	220		
CKUO	41	EVOM	86	RDD	131	TMID	176	SL(1)	221		
CLRUPG	42	EVOR	87	REPEAT	132	TMIR	177	SL(2)	222		
CMODPG	43	EVOT	88	RID	133	TMO	178	SL(3)	223		
CMP	44	FI	89	ROI	134	TMOD	179	TAT(1)	224		
CONMAN	45	FII	90	SMD	135	TMOR	180	TAT(2)	225		

Thus, to carry out Function (d) in Section 7.1, an altered set of MODE variable numbers is entered into SENSY (2 + MODE + 1) through SENSY (2 + MODE + MODE). These are stored in the program array NVAR, of Dimension 12.

7.1.5 Designation of the New Values for the Inputs. The remaining portion of SENSY is used to enter NPASS sets of MODE elements to carry out Function (e) in Section 7.1, i.e., supply the values to be used to alter each variable designated, according to the rule, for each pass. Thus, to recapitulate:

SENSY(1)	MODE	Number of inputs to be tested
SENSY(2)	NPASS	Number of Runs or Passes
SENSY(3) to MODE + 2	NRULE	Set of Rules for Editing
SENSY [(MODE + 3) to (MODE + MODE + 2)]	NVAR	Designation of Input Variables
SENSY [(MODE + MODE + 3) to (MODE + MODE + MODE + 2)]		First Set of Values

and so forth.

7.2 Example of NAMELIST Inputs for Typical Sensitivity Run

If it is desired to investigate the simultaneous variation of failure rate and false no-go fraction, a typical set of values would be as follows:

MODE = 2.

To run three sets of data:

NPASS = 3.

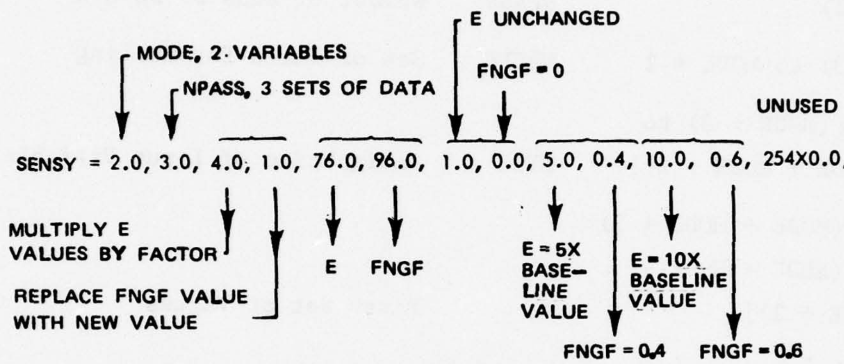
The input designators, from Table 7 are

E 76
FNGF 96

In the baseline run, if FNGF was 0.2 for all LRUs and it is desired to run 0., 0.4, and 0.6, for all LRUs, then Rule 1 is used and 0., 0.4, and 0.6 are assigned at the first, second, and third pass, respectively.

For the failure rate E, all LRUs have different values. Rule 1 is not useful as there is no desire to assign the same failure rate to each LRU. More commonly, it is desirable to run multiples of the baseline. Thus, Rule 4 is useful. If no change is desired for the first pass, then the value 1 is used. (This will show the effect of FNGF = 0, without changing E). If for second and third passes, simultaneously with the doubling and tripling of the false no-go fraction, it is desired to increase the failure rate by factors of 5 and 10, then values 5 and 10 are used.

Then, the input punched for input via NAMELIST/L/ will have the following appearance:



The program will run each pass specified by SENSY. (The baseline data store is "rewound" each time and at the end. The stored baseline data are NOT ALTERED). After the last pass, control returns to the program and execution continues looking for new input data. At this point, another SENSY may be entered and the same saved baseline data will be further sensitivity tested.

If another SENSY is not entered, then new baseline cases may be entered. In such a case, the old saved baseline data are destroyed and the new set is saved. At this point, a control may be entered to stop the program.

Program flow to effect sensitivity control is contained in the detailed LOCAM 5 flow diagram shown previously in Section 3. Table 8 shows a worksheet that is convenient for use in preparing sensitivity input data.

7.3 Sensitivity Testing Specification

Included at the end of Appendix D is a sensitivity NAMELIST input data set that was run with the baseline USAREUR and CONUS data set on the UNIVAC Series 70-45 computed at RCA. As shown, the input cards

TABLE 8. SAMPLE OF SENSITIVITY WORK SHEET (LAYOUT ARRAY OF SENSY)

SENSITIVITY WORK SHEET
(layout of array SENSY)

MODE = ____________
NPASS = ____________

NRULE
1 ASSIGN VALUE
2 ADD VALUE
3 SUBTRACT VALUE
4 MULTIPLY BY VALUE
5 DIVIDE BY VALUE

VARIABLE NAME													NOTES
(sequence no.)		1	2	3	4	5	6	7	8	9	10	11	12	NOTES
NRULE														
NVAR														
VALUES	1st set													
	2nd set													
	3rd set													
	4th set													
	5th set													
	6th set													
	7th set													
	8th set													
	9th set													
	10th set													
	11th set													
	12th set													
	13th set													
	14th set													
	15th set													
	16th set													
	17th set													
	18th set													
	19th set													
	20th set													
	21st set												****	
	22nd set												****	
	23rd set											****	****	
	24th set											****	****	
	25th set										****	****	****	
	26th set										****	****	****	

**** forbidden combination

MODE: Number of variable tested
NPASS: Number of variations
NVAR: See table ____________

for sensitivity testing are placed after the final LRU data set. To use the sensitivity test feature of LOCAM 5, at least three cards must be punched. The first two are generally used as header cards to identify certain factors pertaining to the particular sensitivity run set. The third (and subsequent cards if required — the exact number depending on number of variables and passes to run) is the input array in the NAMELIST format as discussed in Section 7.2.

7.3.1 Sensitivity Output. Along with the SENSY array, the control INHIB may be used to suppress the individual LRU printout. If INHIB = 1 is used, the output page for the final LRU and the totals page only will be printed. If the control INHIB is not activated, the output printout contains the same number of pages as the USAREUR and CONUS baseline results.* These printouts, however, will show the results for the new values of the inputs as controlled by the rules contained in the SENSY NAMELIST array.

The printout of output on totals pages will always be preceded by a printout of the new values of the inputs identified by the designation number given in Table 7. Thus, the new value of the input/inputs assigned by activating the sensitivity test feature of LOCAM 5 is always documented.

7.4 The Versatility Provided by the Built-in Sensitivity Test Feature

The suggested sensitivity parameters and examples shown in Section 9 indicate the versatility of LOCAM 5. The sensitivity test feature represents a powerful tool for the evaluation of logistic support alternatives. Almost any input variable or combination of inputs can be varied through any range of values during any computer run. The use of the technique makes it possible to evaluate multiple effects on logistics cost and effectiveness very rapidly through the spplication of a carefully planned run set.

*Addendum of Changes to LOCAM 3 User's Manual for LOCAM 4 Users, Automated Systems Division, Burlington, Massachusetts, 30 August 1974, Technical Report No. CR-74-588-020.

SECTION 8
LOCAM 5 USE PREPARATION

First or potential users of the LOCAM 5 model can best get acquainted with its use by first getting it to run correctly in their own computer facility. This entails compiling the program and exercising it with the furnished input sample problem. Two sample problems are suggested for this application. Appendix C of the manual sets up a realistic sample problem and describes the steps involved in applying the model.* Both descriptions define the problem, provide the input data base, and give portions of the program output printout. The user will need a computer with 200 kilobytes of memory and a FORTRAN IV, level G or H compiler. This section explains the procedural steps in gathering data and using the model, explains how four different support channels are modeled, and provides important input data user notes.

8.1 The LOCAM 5 Program

The LOCAM 5 program is specifically structured to perform logistic analysis in Army support situations when emphasis is placed on the support channels required for a diversity of operating equipments. In using the program, the analyst structures his input data as a sequence of installed equipments (LRUs) which require support. The program processes each equipment sequentially. Provision is made within the program to store cumulative demand for work at common test and repair facilities for several different LRUs. When setting up the input deck, the LRUs which share such common facilities are grouped. At the last LRU in the group, the cost for the support channels is computed based on the total workload in the accumulator. The accumulator is then reset and the next group of equipments may be processed.

Four types of support channels may be accommodated for a particular scenario being modeled. In the terminology of the program, these are designated as follows:

a) Type I can be located in Field or Depot and is sometimes** used to represent automatic test equipment.

b) Type II can be Depot located only and is sometimes** used to represent factory type manual test equipment.

c) Type III can be located in Field or Depot and is generally used to represent calibration equipment.

d) Type IV is generally used to represent contact support sets in the Field.

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*Op. Cit., Life Cycle Cost Study.

**Test equipment input factors are generic and development, acquisition, and documentation or software cost factors can be subject to varied interpretations.

The maintenance policies and the integer control JTED control the location of the first two types of test equipment as follows:

a) If the value of JTED is input as 1, then Type I can be located in Depot.

b) If the value of JTED is input as 2, Type II can be located in Depot.

c) Type I test equipment can be field located regardless of the JTED value.

The essential features of the four test equipment categories are as follows:

a) Type I is modeled as test equipment performing LRU and module repair at Direct, General, and Depot levels of support. An accumulator will accumulate total work demand over one or more equipments before posting out total costs. Inputs permit specification of LRU and module repair fractions at Direct, General, and Depot. Three accumulators are operative, namely, demand for test equipment, demand for test men and demand for repair men.

b) Type II is modeled as test equipment at Depot for performance of LRU and module repair. Inputs specify the repair capability fractions for LRUs and modules. Three accumulators are operative; namely, demand for test equipment, demand for test men, and demand for repair men. When TYPE I is specified at Depot, Type II at Depot is disabled, i.e., it cannot be concurrently modeled at Depot.

c) Type III calibration sets are modeled directly from inputs relating to total number of sets and men in the Field. There are no accumulators.

d) Type IV contact support sets are also modeled directly from inputs relating to total number of sets and men in the Field. There are no accumulators.

Inputs control the positing out of costs for each type of test equipment and their related costs. Specifically the costs which may be included are as follows:

a) Test Equipment development.

b) Development of technical data or programs for Type I or Type II test equipment.

c) Test equipment acquisition.

d) Nonrecurring training.

e) Operation and maintenance costs for test equipment.

f) Costs for floor space.

g) Costs for test equipment men.

h) Costs for repair men.

The demand for Type I and Type II test equipments includes demand for their self-support, i.e., the computations account for enough test equipment to support the prime equipment and the test equipment itself. Test manpower is based on the total demand for support, i.e., prime equipment and the test equipment itself.

In addition to accounting for the cost for support channels, the program calculates the following:

a) Cost of prime equipment development, acquisition, and salvage value.

b) Cost of spare units, modules, and parts for the prime equipment. The model determines the initial spares acquisition plus on-going consumption. Provision is made to charge for material storage. Salvage value may be taken on annual consumption and on end program terminal inventory. Separately, all or a fraction of the cost of the prime equipment, initial provision, and consumption may be sunk.

c) Companion to the cost of consumption of material is the cost of reordering.

d) Cost for shipping and handling.

e) Cost for supply administration.

Costs are developed over the sequence of the input equipments (LRUs) and carried forward in an accumulator until the last item. Totals are then printed by element of cost. Also, using an input interest fraction, the program phase totals and grand total are printed at present value which can reflect discount as well as inflation (definition of FINT in Appendix B).

8.2 Typical Procedural Steps

Application of the model generally includes the following steps:

a) Establishing the data base.

1) Deployment (scenario).

2) LRU maintenance concepts.

3) Basic data.

4) Equipment (LRU) data.

b) Input deck preparation.

c) Performing baseline computer runs.

d) Performing sensitivity analysis.

e) Presentation of results.

Perhaps the most difficult part of applying the model is gathering the input data (establishing the data base). It is not uncommon for this procedure to take considerable time. This data gathering period encompasses the following tasks:

a) The delineation of prime system/equipment factors.

b) Data generated as the result of operations and support equipment analysis.

c) Determination of logistics factors.

d) Establishment of standard cost/time factors.

The synthesis of viable support systems is dependent upon the results of these activities. Alternate support systems which meet the workload demand are considered as prime tradeoff factors.

Many of the input data items are those the model requires to compute the various workload demands. The LOCAM model operates on demand for support, that is, maintenance workload generated by the prime equipment as postulated in the model. Workload or demand is generated as a function of operating hours expected maintenance incidents, number of operating components, and false failure indications. The support equipment also generates workload by virtue of its need for maintenance. Workload at a representative field test station is computed from:

a) The number of equipments operating in real time.

b) Equipment maintenance incident rate.

c) Test station testing rate for equipment, printed circuit boards, and modules/subassemblies.

d) Modification work order workload.

e) Self-test requirements.

Workload for each field repair station is similarly and separately computed as are test/repair workload at Depot. From workload calculations, LOCAM determines the available time needed at each test station and where demand exceeds a set threshold, additional test stations are added as well as personnel and test station need for maintenance.

8.2.1 Data Gathering Worksheets. One way to organize the data gathering process is through the use of input data worksheets. Tables

Tables 9 and 10 present two worksheets which may be used. These tables list all the input data variables the LOCAM 5 model uses. Definitions for the variables listed are given in the Glossary in Appendix B. Many times, data need not be input for all of the items listed. Particular problems may be structured to analyze a portion of the maintenance workload or the life cycle maintenance support costs. For example, a scenario may include several theaters of operation but initially the model may be used only to examine the USAREUR portion of the deployment. Other ideas of the simplifications possible may be determined by studying the sample problems presented in Appendix C and comparing their input data listings with Tables 9 and 10.*

The beginning user of the LOCAM 5 model is urged to contact RCA or one of the model using Army agencies for consultant help in initially adapting LOCAM 5 to their application. Consultant aid is invaluable not only in setting up the input data, but in determining the expected outputs, determining why they do not occur, and analyzing what the results really mean.

Some problems run on LOCAM are structured during conceptual project phases. At that time, very few "hard" data are available. For that reason, LOCAM 5 incorporates data values called default (BLOCK DATA) data. These data values are resident in the model and are indicated in Tables 9 and 10. The default value may also be used as the input data value if the user knows they are the same (i.e., the variable input data quantity need not be input in that case.) Many of the input data variables are used only to describe a particular LRU. These variables are preceded by an asterisk.

As can be noted, a blank space is left after the BLOCK DATA value is given. Therefore, these tables can be used as work sheets to record the input values prior to keypunching or other input processes. Table 10 is of particular interest because it shows the structure of the LOCAM 5 input arrays such as H, OL, SL, etc. The blank spaces in this instance indicate the number of values necessary to fill the array.

As noted previously, the variables with asterisks in Table 9 indicate LRU descriptive quantities. Because a LOCAM application will typically involve many LRUs, these variables can effectively be removed from this list and placed on multi-LRU worksheets. The use of the next four pages (resulting worksheets) is highly recommended.

8.3 Input Deck Structure

The input to the model is through punched cards. A listing of the inputs for the example problem of Appendix C is contained in Appendix D. Each deck must have the computed control cards plus eight

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*Op. Cit. Life Cycle Cost Study.

TABLE 9. LOCAM 5 NAMELIST INPUT WORK SHEET-1 (PRINTED VALUES ARE DEFAULT VALUES - PUNCH CHANGES ONLY)

ARA	0.	CRU	0.	ODS	0.	TGRMAN	0.
AYZP	1.	CSDEP	0.	*OTF	1.	*TI	0.
CAD	0.	CSDSU	0.	*P	0.	TID	0.
CALMAN	0.	CSGSU	0.	PMR	0.	*TIMW	0.
CALPUB	0.	CTCPUB	0.	*PP	0.	TIO	0.
CALSET	0.	CTRA	0.	PPR	0.	*TIR	0.
CCAL	0.	CTRCAL	0.	PUR	0.	*TMD	0.
CCALP	0.	CTRI	0.	QMM	1.	*TMDD	0.
CCALR	0.	CTRII	0.	QMP	1.	*TMDR	0.
CCSP	0.	CTRSPT	0.	QMU	1.	*TMI	0.
CCSPP	0.	*CUBEM	0.	QTD	0.	*TMID	0.
CCSPR	0.	*CUBEP	0.	QTE	0.	*TMIR	0.
CDDI	0.	*CUBEU	0.	QTI	0.	*TMO	0.
CDEO	0.	CUCE	0.	QTMD	0.	*TMOD	0.
CDFD	0.	*CUP	0.	QTMI	0.	*TMOR	0.
CDID	0.	DAOQL	1.	QTMO	0.	TOE	0.
CDIO	0.	DD	1.	QTO	0.	TOI	0.
CDMAN	0.	DDS	1.	QTPD	0.	*TOMW	0.
CDOE	0.	DI	0.	QTPI	0.	TONMAN	0.
CDOI	0.	DIS	0.	QTPO	0.	*TRC	0.
CDPMAN	0.	*E	0.	RDD	0.	TUMD	0.
CDPRMN	0.	ED	0.	*REPEAT	1.	TUMI	0.
CDRMAN	0.	EDS	0.	RID	0.	TUMO	0.
CEN	0.	*EE	1.	ROI	0.	WD	168.
*CEND	0.	EVDM	1.	SMD	0.	WDM	168.
CFTD	0.	EVDR	1.	SMF	0.	WDR	168.
CGMAN	0.	EVDT	0.	SMI	0.	WI	168.
CGRMAN	0.	EVIM	1.	SMO	0.	WIM	168.
CI	0.	EVIR	1.	*SPE	0.	WIR	168.
CII	0.	EVIT	0.	SPEV	1.	*WM	0.
*CKIT	0.	EVOM	1.	SPEVR	1.	WO	168.
CKMD	0.	EVOR	1.	SUD	0.	WOM	168.
CKMI	0.	EVOT	0.	SUI	0.	WOR	168.
CKMO	0.	FI	0.	SUO	0.	*WP	0.
CKPD	0.	FII	0.	SVE	0.	*WTKIT	0.
CKPI	0.	FINT	0.	SVR	0.	*WU	0.
CKPO	0.	FMD	1.	SVT	0.	YAT	0.
CKUD	0.	FMI	1.	SVV	0.	YD	0.
CKUE	0.	FMO	1.	TALMAN	0.	YMWO	0.
CKUI	0.	FN	0.	TATE	0.	YP	0.
CKUO	0.	FNGF	0.	*TC	0.	YR	0.
*CLRUPG	0.	*FNSP	1.	*TD	0.	YZ	0.
*CMODPG	0.	FSA	0.	TDI	0.	ZFL	.99999
*CMP	0.	FTI	0.	TDMAN	0.	*ZI	0.
CONMAN	0.	FTII	0.	*TDMW	0.	*ZO	0.
CONTCT	0.	FTM	0.	TDPMI	0.	IO	2
*CPE	0.	FTP	0.	TDPMII	0.	IS	1
CPI	0.	FTU	0.	TDPRI	0.	JTED	1
CPII	0.	FUD	1.	TDPRII	0.	NA	1
*CPP	0.	FUI	1.	*TDR	0.	NU	1
*CPUBII	0.	FUO	1.	TDRMAN	0.	DTI	0
CRI	0.	HPM	0.	TEO	0.	DTO	0
CRII	0.	HPP	0.	*TF	0.	STAT	0
CRM	0.	HPU	0.	*TFR	0.		
CRP	0.	OD	0.	TGMAN	0.		

*LRU variables - use LRU worksheets.

TABLE 10. LOCAM 5 NAMELIST INPUT WORKSHEET-2 (PRINTED VALUES ARE DEFAULT VALUES, PUNCH CHANGES ONLY

```
GA      0. ______     H(1)    0.
GB      0. ______     H(2)    1.
GD      0. ______     H(3)    1.
GE      0. ______     H(4)    1.
GF      0. ______     EACAL   0.
GG      0. ______     EACSP   0.
GH      0. ______     ETI     0.
GL      0. ______     ETII    0.
GM      0. ______     H       0.,1.,1.,1.,   _____,_____,_____,_____
GN      0. ______
GO      0. ______     OL      0.,0.,0.,      _____,_____,_____
GP      0. ______
GQ      0. ______     SL      0.,0.,0.,      _____,_____,_____
GR      0. ______
GS      0. ______     OST     0.,0.,0.,      _____,_____,_____
GT      0. ______
                      TAT     0.,0.,0.,      _____,_____,_____

TAYZ    1.,1.,1.,1.,1.,1.,1.,1.,1.,1.,   ___,___,___,___,___,___,___,___,___,___

ZU      .99999,.99999,.99999,.99999      _____,_____,_____,_____

ZM      .99999,.99999,.99999             _____,_____,_____

ZP      .99999,.99999,.99999             _____,_____,_____
-------------------------------------------------------------------------------

NB      0 ______
INHIB   0 ______
IPAGE   0 ______
SENSY    266*0.     __________________________________________
       ___________________________________________________________
```

SYSTEM__________ LRU DATA FORM NO. 1 DATE__________

LRU	CUP	CMP	CPP	MTBF	MTBMA	E	P	PP	EE	REPEAT	CEND	CPE	MAINT. POLICY		
	$	$	$	OP HR	KxMTBF	$\frac{1}{MTBMA}$					$	$			

SYSTEM ____________ LRU DATA FORM NO. 2 DATE ____________

LRU	WU	WM	WP	CUBEU	CUBEM	CUBEP	TF	TFR	TMO	TMOR	TI	TIR	TMI	TMIR	FNSP

LRU DATA FORM NO. 3

SYSTEM ____________

LRU	TD	TDR	TMD	TMDR	TRC	TC	CLRUPG	CMODPG	CPUBII	CKIT	WTKIT	ZI	ZO	OTF	SPE

SYSTEM ________ LRU DATA FORM NO. 4 ________

LRU	TMOD	TMID	TMDD	TOMW	TIMW	TDMW									

header cards preceding the data. The first four header cards may be either blank or punched, but they must all be there. The structure of the input deck is shown in Figure 30 and comprises the following elements:

a) Control Cards: These cards specify the job name, assign tapes and/or discs to be used, and the program execute card. They apply to the particular computer being used.

b) Header Cards:

1) Text Cards - These four cards may contain information in Columns 1 through 72. The purpose of the text cards is to enable the analyst to print up to four lines of identifying information on each computer output page.

2) "Analysis" Card - One card provides information in Columns 1 through 18. This may be identification of the analyst or some specific information on the analysis.

3) Date Card - One card using the first 18 columns to allow for printing the date on the output pages.

4) "Units" Card - One card stating the units of the output and totals printouts in words (Columns 1 to 36), and the numerical value of the multiplier to be used (Columns 42 to 51).

5) Total Card - TOTAL is new to LOCAM 5. It is a non-recurring input card which indicates that a summation of each LRU for all theaters is called. Individual LRUs in the input data for each case (theater) must be identically sequenced for the LRU summation to be meaningful. The number of distinct LRUs for which a total is to be taken over all cases in a concept must also be punched on the TOTALS card (Section 3.1.1).

c) Data Cards: The LOCAM 5 model input data uses the NAMELIST form. This allows data to be modified easily from one program pass to another. Only the elements of data that are different from those used in the preceding pass need to be entered. The deck is made up of a series of LRU "boxes," each series representing a particular case to be run. These cases define a support alternative and the related geographical scenarios. In each box, two leader cards provide identifying information (Columns 1 to 18 and 1 to 72 in that order). Next follows the NAMELIST (Columns 2 to 72), with the final entry being an &END or $ depending on the computer used. The very last card in the deck contains a /* or other suitable end file card in Columns 1 and 2 to indicate the end of all data.

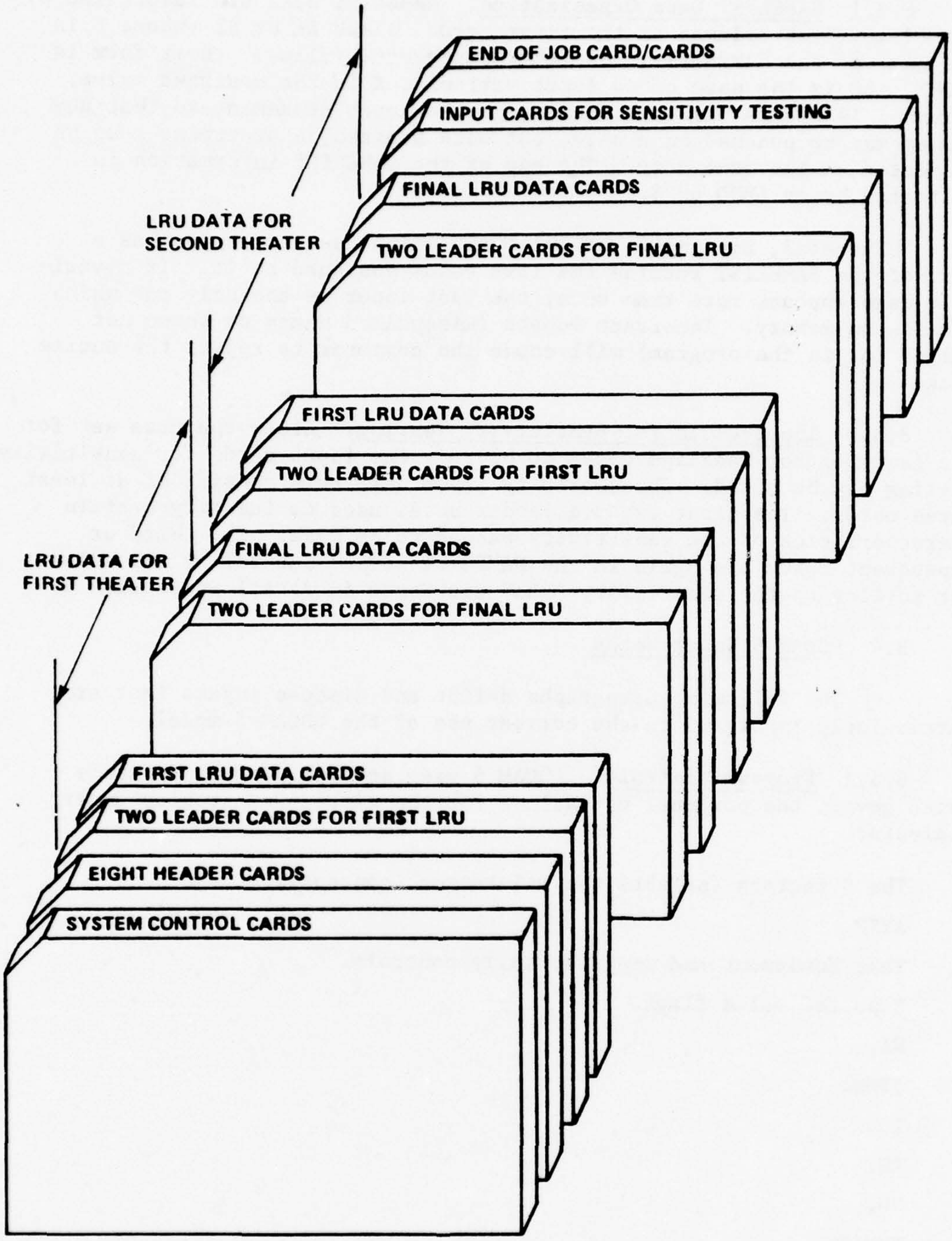

Figure 30. Input deck structure for two theater scenario.

8.3.1 NAMELIST Data Organization. NAMELIST data are identified by the first three columns on the first card: blank &L or $L (where L is the name of the NAMELIST). NAMELIST statements follow: their form is ABC=X, ABC is the name of an input variable, X is the assigned value. Column 1 is always blank; a comma separates each statement so that any number may be punched on a card, but once started, a statement must be completed on the same card. The end of the NAMELIST information is indicated by an &END or $.

In general, any input variable name which does not appear as a part of the NAMELIST retains the last value assigned to it. If a variable name appears more than once, the last input is the only one which remains in memory. Incorrect inputs (misspelled names or those not called for in the program) will cause the computer to reject the entire deck.

8.3.2 Input Cards for Sensitivity Testing. After the data set for the last box for baseline cases to be run, the input cards for sensitivity testing may be added. The sentivity input data sets consist of at least three cards. The first two are leader cards used to identify certain characteristics of the sensitivity passes to be made. The third or subsequent cards are again in the NAMELIST format but follow the rules for setting up the sensitivity ARRAY discussed in detail in Section 7.

8.4 LOCAM 5 Input Notes

The following paragraphs define and discuss inputs that are particularly important to the correct use of the LOCAM 5 model.

8.4.1 Program Controls. LOCAM 5 uses several program controls which govern the computer operations for the particular problem under analysis:

The G factors (selects the maintenance concept).

AYZP.

Test Equipment and manpower tally controls.

Expected value flags.

NA.

JTED.

IO.

IS.

NU.

INHIB.

the first four controls in the preceding list are real numbers; the rest are integer controls.

a) G Factors: The maintenance concept is generally punched for each LRU in the data set because it is likely to vary between LRUs. Reference to Appendix D indicates that this approach was used in setting up the sample problem data set. When combination policies are used for the Class 2 and Class 3 LRU maintenance concepts, the sum of the maintenance policy fractions must total to unity to assure that all work is accounted for.

b) AYZP - AYZP governs the selection of supply/maintenance rules. A value of unity was used for the sample problem described in Appendix C. This selected the use of MIRADCOM maintenance rules.

c) Test Equipment and Manpower Tally Controls: LOCAM 5 incorporates four tally controls associated with the four possible types of test equipment as follows:

1) ETI Type I test equipment.

2) ETII Type II test equipment.

3) EACAL Type III test equipment.

4) EACSP Type IV test equipment.

These controls govern the posting of test equipment and manpower costs. Only the values 0 and 1 are permitted. The tally is taken when unity is input. Type I and Type II tallies are taken in accordance with the expected values flags which control the use of shared test equipment and manpower or integer round off. Type III and Type IV can only be deployed as dedicated test equipment sets and teams of manpower.

d) Expected Value Flags: There are nine of these flags in the LOCAM 5 program. They are used to designate whether shared (expected value) or dedicated test equipment and manpower will be used. Only the values 0 and 1 are permitted. Zero selects dedicated test equipment and manpower and unity selects shared test equipment and manpower.

The program uses the following mnemonics for these flags:

EVOT EVIT EVDT	Flags for test equipment at Direct Support, General Support, and Depot, respectively.
EVOM EVIM EVDM	Flags for test manpower at Direct Support, General Support, and Depot, respectively.

EVOR
EVIR
EVDR

Flags for repair manpower at Direct Support, General Support, and Depot, respectively.

e) NA - NA controls the number of system availability modes to be tallied. Values from 1 to 10 can be assigned to NA permitting the determination of up to 10 availability modes. NA is input in combination with TAYZ (Section 8.4.2).

f) JTED - JTED controls the designation of Depot test equipment (Type I or Type II). For the sample problem (Appendix C), JTED=2 was input which designated Type II test equipment at Depot.

g) IO - IO controls the printout of NAMELIST, an abbreviated NAMELIST or a sequenced listing of all inputs. IO=0 inhibits the printout of the inputs. IO=2 prints out all NAMELIST inputs. IO=1 prints the abbreviated NAMELIST. When IO=3 is input, the entire sequence of LRU input data for all LRUs will be printed. It is recommended that this control be used with the last LRU in an input sequence of LRUs. Thus, for example, if the user has a system consisting of eleven LRUs and he is examining them in five different deployments, then his total set of LRU inputs is eleven times five, or fifty-five. The control IO=3 ought to be input with the fifty-fifth set of LRU data. When so input, all fifty-five sets of input data will be printed in columnar fashion to facilitate examination of the sequence of inputs. This feature greatly facilitates the discovery of inadvertant input sequence error from LRU to LRU.

i) IS - IS controls the program reset functions (Appendix B). For the final LRU of the USAREUR data set in Appendix D, IS = 1 is input. This causes all inputs used for the very first LRU of the data set to be recalled for next LRU in the input sequence. Therefore, any inputs which pertain specifically to that LRU need to be keypunched for the next system data set. IS = 1, also resets availability, workload accumulators, and case total accumulators.

j) NU - NU controls the printout of totals pages. It is general input with the final LRU of theater or case. In the present problem (Appendix C), NU = 1, is input with the final LRU of the USAREUR deployment. This caused the printout of the CASE TOTALS page for the USAREUR scenario. For the final LRU in the CONUS sequence, NU = -3 is input causing the printout of the CASE TOTALS page for CONUS plus the printout of summary TOTALS pages for each LRU for both theaters. Finally, a GRAND TOTALS summation of the CASE TOTALS for USAREUR plus the CASE TOTALS for CONUS is printed out.

k) INHIB - INHIB controls the printout of the individual LRU OUTPUT pages. It is input as either one or zero. Unity inhibits the printout of LRU OUTPUT and zero allows the OUTPUT page to be printed.

8.4.2 Array Inputs. LOCAM 5 uses the following array inputs:

H

TAYZ

ZU, ZM, ZP

SENSY

OL

OST

SL

TAT

a) H - H controls the allowable LRU stock locations. It is permissible to have LRU stock at any or all of four supply locations: at Equipment Level, at Direct Support, at General Support or at Depot. In the sample problem (Appendix C), H was input as:

H = 4*1.,

with the first LRU of the data set. This signifies that LRU stock is permitted at all locations because all elements of the array are input as unity. An input of zero would inhibit LRU supply at a particular location depending which element of the array was input as the zero. The program will inspect the inputs QTE, QTO, QTI, and QTD to see if stock quantities have been input. If they have been input, the corresponding H element will be set to unity even if input as zero. This change to H, if made, is permanent until H is again input with some subsequent LRU.

b) TAYZ, Availability Tally Control, is the availability formulation in LOCAM 5 which includes a set of ten availability accumulators. A new input, NA, described in Section 8.4.1, specifies how many of the ten accumulators are active. TAYZ is defined as an array of dimension ten. However, a value must be input for each of the availability accumulators. In the environment of the CDC 6600, ten values should be entered. Only the first NA of the ten is actually used; the remaining values have no effect.

For example, in the sample problem (Appendix C), the system consists of eleven LRUs. The arrangement of the LRUs in the input tray is such that the first four LRUs constitute the first subsystem, the next five constitute the second subsystem, and the last two constitute the third subsystem. In this instance, it is desirable to keep the availability tally for the total system and also for each subsystem. Four tallies are required; therefore, the input NA = 4 is used and the following are input for TAYZ:

LRU No.	
1	TAYZ = 1., 1., 8*0.,
2	
3	
4	
5	TAYZ = 1., 0., 1., 7*0.,
6	
7	
8	
9	
10	TAYZ = 1., 2*0., 7*1.,
11	

All LRUs are tallied into the first accumulator, i.e., the first element of the TAYZ array is unity for every LRU. The first four LRUs are tallied into the second accumulator, i.e., the second element of TAYZ is unity for the first four LRUs and zero for all others. LRUs 5 through 9 are tallied into the third accumulator, i.e., the third element of TAYZ is unity for these LRUs and not for any others. The last two LRUs will be tallied into the fourth accumulator, i.e., the fourth element of TAYZ is unity for these two and zero for all others. Values of TAYZ beyond the fourth element are immaterial because NA = 4.

On the case total output page, four availabilities will be printed across the page. The first is the system availability. The second is the availability of the first subsystem. The third is for the second subsystem. The fourth, and last, is for the third subsystem.

c) ZU, ZM and ZP - Stock Round-off Arrays - Array ZU., of dimension four, gives the round-off rule for LRU stock at Equipment, Direct Support, General Support, and Depot supply locations. Similarly, array ZM of dimension three gives the rule for module stock at Direct Support, General Support, and Depot locations. Array ZP gives the rule for part stock at the same three locations. The following inputs for these factors:

ZU = .5, .5, .99, .9999999

ZM = .9, .99, .9999999

ZP = .9999999, .9999999, .9999999,

in LRU stock would mean:

1) At the E level, round one-half, i.e., if the demand for spare LRUs at E is less than one-half, stock zero.

2) At the Direct Support level, one-half is rounded. If the demand has a fractional part less than one-half, the next lower integer is used. If the demand is more than one-half, the next higher integer is stocked.

3) At the General Support level, if the demand fraction is greater or equal to 0.01, the next higher integer is stocked; otherwise, the next lower integer is stocked.

4) At the D level, if the demand fraction is greater or equal to 0.0000001, the next higher integer is stocked; otherwise the next lower integer is stocked.

Similar interpretations apply to the ZM and ZP rules. The order of the ZM and ZP arrays is Direct Support, General Support, and Depot.

These rules are used for both the LOCAM Supply Rules and the MIRADCOM Maintenance Rules. Fractional demands for stock are rounded up or down to an integer based on the addition of the Z fractions to the basic demand followed by truncation of the result of the addition to obtain a whole number.

d) SENSY is the array for sensitivity testing SENSY is discussed in detail in Section 7.

e) TAT, OL, SL and OST are arrays for MIRADCOM Maintenance Rules. LOCAM 5 incorporates three basic methods for calculating initial stockage (definition for AYZP in Appendix B). When using the MIRADCOM Maintenance Rule, four sets of pipeline inputs are in the form of arrays. These MIRADCOM pipelines are known as "maintenance-turn-around times" for repairables and "operating level," "safety-level," and "order-ship-times" for consumables. When used in this mode, former LOCAM/COAMP pipeline times are used to specify down-time if stock outage occurs. Down-time, in this context, should reflect the expedited time to obtain a spare.

The TAT, OL, SL and OST are all input in days and are arrays of Dimension 3. The order of each array is for Direct Support, General Support, and Depot supplies.

8.4.3 <u>New Inputs</u>. LOCAM 5 contains four additional NAMELIST inputs not in previous versions of the model:

STAT
DTI
DTO
IFLAG.

STAT, DTI, and DTO are new inputs associated with the use of MIRADCOM Maintenance Rules. STAT is the shipping turn-around time in days for an LRU to go from a Field maintenance point to Depot and return. DTI

is the expected delay time in days at General Support in evacuating a failed LRU to Depot. DTO is the expected delay time in days at Direct Support in evacuating a failed LRU to General Support or Depot.

IFLAG - IFLAG has been added to NAMELIST to suppress the printout of LRU summary totals. The summation of costs, etc. for each LRU for all theaters is suppressed if IFLAG=1 is input (description of program initialization card (TOTAL" in Section 8.3).

SECTION 9
PROGRAM OUTPUT AND RESULTS REPORTING

9.1 Program Output Printouts

LOCAM 5 provides printed program outputs of five types:

a) LRU.

b) Cost totals.

c) Individual LRU summary totals.

d) NAMELIST.

e) Sequenced listing of input data.

Printouts (a) and (b) are also modified slightly when the sensitivity option is used. These two printouts then indicate the fact that sensitivity was employed by additionally printing the input variables selected with their respective input sensitivity values. This section explains the five output printout types via examples and illustrates some ways the printed results data may be displayed graphically.

9.1.1 LRU Printout. The individual component or LRU printout is shown in Figures 31 and 32. Figure 31 is for an LRU where the service channel data is not tallied; Figure 32 shows the result when the appropriate tally flags are input as unity. (Appendix B glossary contains explanation of tally controls ETI, ETII.) The main difference between the two outputs is that Figure 32 includes test equipment and maintenance manpower cumulative information that has accrued since the last tally was taken. In this instance, a tally is taken for Type I test equipment by inputting ETI=1. with the other LRU input data. In addition to cost data, the printout shows quantities of units, modules, and parts. The module and part data are per module and part type. Test equipment and repair channel data show the fraction of real time that the service channel is utilized. EACH refers to the individual LRU while CUM refers to the cumulative utilization since the last tally was taken. Also shown in the upper right hand portion of the output pages are the operational and inherent availabilities for the individual LRU.

9.1.2 Cost Totals Output Printout. Figure 33 shows a sample LOCAM 5 totals summary printout. The header information is the same as for the preceding individual LRU pages (Figure 32). The Grand Total Cost presented in the upper left portion of Figure 33 lists the top level cost items in the Grand Total Cost summation. These items have been formulated in four distinct time phases:

```
                 COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                  USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                   MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                     ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 2 LRU NO. 3                                                       ANALYSIS - THREE LRU CLASSES
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS          DATE - JANUARY 7,1977

PRESENT VALUE COST TOTAL
EACH      CUM
   2257.     17035.     THOUSANDS OF DOLLARS                AVAILABILITY= .999928  INHERENT=  .999928
PRIME     T.E.       TE SPACE MANPOWER  SUPPLY    ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
     0.        0.         0.        0.     2089.       3.        0.      158.         8.     2257.

PROVISION        INITIAL BUY        REORDER BUY         CONSUMED          RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART
  64.    9.    2.  205.  214.  216.   20.   50.  180.    0.    0.   17.   64.    9.    0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA
               DIRECT                                        GENERAL                                   DEPOT
    T.E.                          REPAIR    T.E.                        REPAIR    T.E.                            REPAIR
    EACH       CUM      EACH       CUM      EACH      CUM      EACH       CUM      EACH       CUM      EACH        CUM
  0.0000    0.0000    0.0000    0.0000     .0033    .0349    .0077     .0372     .0066     .0603     .0117      .0818
            0.0000              0.0000              .0349              .0372               .0603                 .0818


EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
   2257.     17035.     MANPOWER        0.      DELTA          0.      PV DELTA        0.
INITIAL PROVISION QUANTITIES OF
                        UNITS                                      MODULES                                       PARTS
  EQPT.     DIRECT    GENERAL       DEPOT       DIRECT    GENERAL      DEPOT        DIRECT     GENERAL       DEPOT
    0.        54.        10.           0.           0.        2.          7.           0.          0.           2.
COST OF INITIAL PROVISION                                          RESIDUAL
        EQPT.       DIRECT      GENERAL       DEPOT       TOTAL
UNIT      0.         1017.        188.          0.        1205.        1205.
MODULE                  0.         24.         84.         108.         108.
PART                    0.          0.          0.           0.           0.
```

Figure 31. Output format for individual LRU when test equipment and manpower tally is not taken.

```
                    COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                     USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                      MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                         ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 2 LRU NO. 5                                                              ANALYSIS - THREE LRU CLASSES
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS                  DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL
EACH       CUM
    3134.     21629.     THOUSANDS OF DOLLARS                AVAILABILITY=  .999947  INHERENT=  .999947
PRIME     T.E.        TE SPACE MANPOWER  SUPPLY    ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
      0.      2219.         0.      282.      489.        2.        0.      136.         6.     3134.

PROVISION        INITIAL BUY        REORDER BUY         CONSUMED          RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART
   49.   13.    1.  190.  203.  204.   20.   50.  100.    0.    0.   13.   49.   13.    0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA
              DIRECT                                       GENERAL                                          DEPOT
    T.E.                               REPAIR     T.E.                            REPAIR     T.E.                              REPAIR
    EACH       CUM        EACH          CUM       EACH        CUM        EACH       CUM       EACH        CUM       EACH        CUM
  0.0000     0.0000     0.0000       0.0000      .0042      .0434       .0068      .0522      .0040      .0701      .0068      .0982
             0.0000                  0.0000                 .0434                  .0522                 .0701                  .0982

ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
           DIRECT                            GENERAL                                 DEPOT
T.E.        TE MEN     REP MEN    T.E.       TE MEN     REP MEN    T.E.       TE MEN     REP MEN
    0.         0.         0.        2.          0.         0.         0.         0.         0.
0.0000                            .0478                           0.0000

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH       CUM
    3134.     21629.     MANPOWER      282.     DELTA          0.     PV DELTA        0.
INITIAL PROVISION QUANTITIES OF
                        UNITS                                                 MODULES                                            PARTS
  EQPT.      DIRECT     GENERAL      DEPOT         DIRECT     GENERAL       DEPOT        DIRECT      GENERAL       DEPOT
    0.         36.          8.          5.             0.          2.         11.            0.           0.          1.
COST OF INITIAL PROVISION                                                 RESIDUAL
          EQPT.       DIRECT      GENERAL       DEPOT       TOTAL
UNIT        0.          180.          40.          25.        245.        245.
MODULE                    0.           8.          44.         52.         52.
PART                      0.           0.           0.          0.          0.
```

Figure 32. Output format for individual LRU when test equipment and manpower tally is taken.

```
                COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                 USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                  MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                    ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

ANALYSIS - THREE LRU CLASSES                                                                DATE - JANUARY 2,1977
                                                   CASE TOTAL
COST TOTALS, COST IN THOUSANDS OF DOLLARS                                               RECURRING COSTS
     INSTALLED EQUIPMENT                  0.
     TEST EQUIPMENT                    5730.                                    T.E. MAINTENANCE        364.
     TEST EQUIPMENT SPACE                 0.                               DEPOT SPACE/UTILITIES          0.
     MAINTENANCE MANPOWER              1376.                FIELD      600.  DEPOT      620. TOTAL      1300.
                                                   TRAINING FIELD       40.  DEPOT       36. TOTAL        76.
     SUPPLY MATERIAL                  54473.                                            SUPPLIES      14000.
     REORDERING                          51.                                          REORDERING         51.
     MATERIAL STORAGE                     7.                                    MATERIAL STORAGE          7.
     SUPPLY ADMINISTRATION             1479.                                INVENTORY MANAGEMENT       1186.
     SHIPPING AND HANDLING              189.                                            SHIPPING        189.

     GRAND TOTAL COST                 63305.                                     TOTAL RECURRING      17172.

     PRESENT VALUE                                                          COST OF INITIAL PROVISION
     DEVELOPMENT                       3619.                                               UNITS      38539.
     ACQUISITION                      42513.                                             MODULES       1929.
     OPERATION AND MAINTENANCE        17172.                                               PARTS          5.
     END LIFE SALVAGE                     0.                                     TOTAL PROVISION      40473.

     GRAND TOTAL                      63305.

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

     MAINTENANCE MANPOWER              1376.
     GRAND TOTAL COST                 63305.
     PRESENT VALUE
     OPERATION AND MAINTENANCE        17172.
     GRAND TOTAL                      63305.         DELTA         0.          PV DELTA         0.
   CAYZ=  .998660  .999842  .999119  .999698
  CAYZI=  .998660  .999842  .999119  .999698
                           MAN-E        DIRECT          GENERAL        DEPOT
HOURS PER DAY
  TEST EQUIPMENT           4.539         0.000           3.043         4.022
  REPAIR                   0.000         0.000           4.544         7.013
NUMBER OF MEN
  TEST EQUIPMENT           0.000         0.000           1.065         1.408
  REPAIR                   0.000         0.000           1.590         2.455
```

Figure 33. Output format for cost-totals summary.

a) Development.

b) Acquisition.

c) Operation and Maintenance.

d) End of Program Salvage.

The equations used in each time phase calculation and the Grand Total cumulation follow:

a) Development:

$$CD = CED + CTSD + CTSOFT$$

where CED is prime equipment, CTSD test equipment, and CTSOFT is the cost of technical data or programming.

b) Acquisition:

$$CP = CEP + CTSP + CIVP + CSAP + CMPPY$$

where CEP is prime equipment, CTSP is test equipment, CIVP is initial material allowance, CSAP is entry of items for supply administration, and CMPPY is nonrecurring training costs.

c) Operation and Maintenance:

$$CR = CTSR + CFR + CMPR + CMPRR + CIVR + CROR + CWHR + CSAR + CSHR + CSVR$$

where CTSR is test equipment support, CFR is test equipment space at Depot, CMPR is maintenance manpower, CMPRR is repair manpower, CIVR is material consumption, CROR is reordering, CWHR is material storage, CSAR is ongoing supply administration, CSHR is shipping and handling, and CSVR is salvage on consumed material.

d) End of Program Salvage:

$$CS = CEV + CTSV + CIVV$$

where CEV is salvage on installed equipments, CTSV is salvage on test equipment, and CIVV is salvage on residual inventory.

The Grand Total Cost is computed as GCT = CD + CP + CR + CS the sum of the four time phased costs.

Following the heading on Figure 33, costs are broken down in four different ways:

a) Grand total cost elements.

b) Recurring (O&M) cost elements.

c) Initial provisioning cost elements.

d) Present value cost elements.

First on the left side of the Figure 33, the following breakdown is given:

a) Installed Equipment: The cost to develop and procure the fielded prime equipment less salvage (this cost was not included in the run on which Figure 33 is based).

b) Test Fquipment: The sum of the costs for test equipment development, test equipment procurement, test equipment maintenance, and test programs or documentation less salvage.

c) Test Equipment Space: The charges for the space and utilities required by the test equipment.

d) Maintenance Manpower: The cost for all maintenance manpower for Field and Depot test and repair including their training and other special manpower costs for calibration and field contact teams at the equipment level, if applicable.

e) Supply Material: The cost of initial provisioning of units, modules, and parts plus the cost for supplies consumed during the O&M phase less salvage value of residual inventory.

f) Reordering: The administrative costs for reordering units, modules, and parts throughout the life of the program.

g) Material Storage: The sum of all charges for storage of units, modules, and parts at the organizational, intermediate, or depot levels, if applicable.

h) Supply Administration: The sum of the costs to enter and keep all unique items in the inventory.

i) Shipping and Handling: The cost for shipping units, modules, and parts throughout the life of the program.

j) Grand Total Cost: The sum of all of the cost elements given previously.

The entry RECURRING COSTS at the upper right-hand portion of Figure 33 gives a breakdown of all recurring costs for operations after the equipment is fielded including the following:

a) Test equipment maintenance.

b) Test equipment space/utilization charges.

c) Manpower for operating test equipment plus repair manpower.

d) Recurring training costs.

e) Costs of consumed supplies.

f) Reorder costs.

g) Storage costs.

h) Invensoty management.

i) Shipping Costs.

The entry COST OF INITIAL PROVISION lists the pipeline costs for units, modules, and parts. It also gives the sum of these costs.

The second entry on the left-hand side of Figure 33, under the heading PRESENT VALUE, can be used to show present values costs assuming some yearly discount rate, if desired (definition for FINT in Appendix B). Present value costs are broken down as follows:

a) Development: The sum of prime equipment development, test equipment including equipment for fault isolation, calibration, and field test at the equipment level plus software or other documentation costs.

b) Acquisition: The sum of the costs for procurement of prime equipment, initial provision of units, modules, and parts, the nonrecurring training costs plus the cost to enter items in the inventory.

c) Operation and Maintenance: The sum of the costs of "operation and maintenance" of the entry previously listed. This value, however, can be discounted.

d) End Life Salvage: Salvage credits taken for prime equipment, test equipment, and inventory items can be shown here.

e) Grand Total: This number is the same as the previous Grand Total entry, unless the discounting feature is activated by inputting FINT $\neq$ 0.

LOCAM 5 has the option to use dedicated or expected value (shared) test and repair manpower (definitions for expected value flags for manpower – EVOM, EVIM, EVDM, EVOR, EVIR, and EVDR in Appendix B). If dedicated manpower is selected, the program also computes the expected value costs for all field manpower. The results of this computation are printed out under the heading EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL in the lower portion of Figure 33. The program also computes the cost differential (depending on what was input for the expected value flags) between dedicating the manpower and sharing the manpower and produces the output called DELTA. The object of the DELTA computation is to display the cost penalty of dedicated manpower in the field as opposed to shared manpower in the field.

The availability products are also shown for all the LRUs that are considered to operate as functional systems. Both the operational CAYZ and inherent CAYZI availability products are printed out.

Finally, the program computes and prints out the test equipment and repair channel utilization data. These results are for all equipment, DS, GS, and Depot locations. They summarize the test and repair channel utilization in hours per day and the number of men required to perform the maintenance functions.

9.1.3 GRAND TOTAL Printout. The LOCAM 5 program also prints out a GRAND TOTALS printout, when called for which is essentially in the same format as Figure 33. This GRAND TOTALS is activated when the control NU = -3 is input and serves the purpose to summarize the summation of the LCC for two or more deployments or theaters of operation.

9.1.4 Summary LRU Cost Totals. LOCAM 5 also provides the versatility to sum up and print out the LCC for two or more theaters of operation on an individual LRU basis (discussion of header cards in Section 8.3). Figure 34 shows the format for a summary LRU cost TOTAL printout.

9.1.5 NAMELIST Printout. Tables 11 and 12 show typical NAMELIST/ L/ and /LL/ printouts, respectively. When called for, these printouts occur just prior to the individual LRU output page and show the input values associated with the output for that LRU. The formats shown are those printed by the UNIVAC Series 70 computer.

9.1.6 Sequenced Listing of Input Data. A feature of LOCAM 5 which greatly facilitates examination of inputs is the printout of a sequenced listing of all input data factors. This section of the program is activated by inputting the value IO = 3, and is usually done on the final LRU of the input data set. The printout lists the inputs in an arbitrary sequence ordered to make the finding of a given input a simple task. However, the LOCAM analyst must familiarize himself with the order to find the quantity he is interested in quickly. Figure 35 is a sample page extracted from a multipage listing.

9.2 Reporting the Results

The application of the LOCAM 5 computer model facilitates evaluation of the impact of logistics in terms of cost and effectiveness for different support postures for fielded military equipment. Costs may be based on current fiscal year dollars or may be discounted assuming a yearly interest rate. Costs already expended can be sunk.

9.2.1 Baseline Support Cost Comparisons. Many times, alternate support approaches are analyzed versus a baseline or existing maintenance support approach. Many ways can be used to explain and display the

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                    COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                     USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                      MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                        ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.
UNIT - CLASS 3 LRU NO. 2                                                          ANALYSIS - THREE LRU CLASSES
   TOTAL                                                                            DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL
EACH      CUM
    30572.    83474.     THOUSANDS OF DOLLARS
PRIME    T.E.       TE SPACE MANPOWER  SUPPLY    ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
        0.     4400.        0.      1206.    24531.       9.        10.       258.      157.    30572.

PROVISION        INITAL BUY                                    CONSUMED          RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART                          UNIT  MODULE PART UNIT  MODULE PART
  237.   12.     4.  418.  430.  434.                           0.     0.   53.  237.   12.    0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA
             DIRECT                                          GENERAL                                 DEPOT
     T.E.                             REPAIR    T.E.                           REPAIR    T.E.                           REPAIR
     EACH        CUM        EACH        CUM     EACH        CUM       EACH        CUM    EACH        CUM       EACH        CUM
   0.0000     0.0000      0.0000     0.0000    .0218      .0326      .0640      .0891   .0388      .2057      .1444      .4016
              0.0000                 0.0000               .1269                 .2835              .2057                 .4016

ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
        DIRECT                           GENERAL                                 DEPOT
T.E.       TE MEN     REP MEN   T.E.      TE MEN    REP MEN   T.E.      TE MEN    REP MEN
   0.         0.         0.        1.        0.        0.        0.        0.        0.
0.0000                          .0359                         0.0000
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
          DEPOT
T.E.       TE MEN     REP MEN
     2.         1.         2.
  .2263

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
    30572.    83474.    MANPOWER      1206.    DELTA          0.    PV DELTA        0.
INITIAL PROVISION QUANTITIES OF
                        UNITS                                                    MODULES                                    PARTS
   EQPT.      DIRECT    GENERAL       DEPOT          DIRECT    GENERAL    CEPOT          DIRECT     GENERAL      DEPOT
    0.        145.         39.         53.              0.        2.       10.              0.          0.          4.
COST OF INITIAL PROVISION                                                    RESICUAL
       EQPT.       DIRECT       GENERAL       DEPOT        TOTAL
UNIT      0.        10913.        2935.        3989.       17837.      17837.
MODULE                 0.           65.         325.         390.        390.
PART                   0.            0.           1.           1.          0.
```

Figure 34. Individual LRU summary totals printout.

TABLE 11. NAMELIST/L/ PRINTOUT (UNIVAC SERIES 70 COMPUTER SYSTEM SOFTWARE)

```
 EL
 ARA    =  3.9999998E-01, AYZP   =  1.0000000E 00, CAD    =  1.7000000E 02, CALMAN=  0.0000000E 00,
 CALPUB=  0.0000000E 00, CALSET=  0.0000000E 00, CCAL   =  0.0000000E 00, CCALP  =  0.0000000E 00,
 CCALR  =  0.0000000E 00, CCSP   =  0.0000000E 00, CCSPP  =  0.0000000E 00, CCSPR  =  0.0000000E 00,
 CDDI   =  3.2999998E-01, CDED   =  0.0000000E 00, CDFD   =  3.2999998E-01, CDID   =  3.2999998E-01,
 CDIO   =  0.0000000E 00, CDMAN  =  1.6600000E 04, CDNE   =  0.0000000E 00, CDOI   =  0.0000000E 00,
 COPMAN=  2.6100000E 04, COPPMN=  2.6100000E 04, CORMAN=  1.6600000E 04, CEN    =  4.5100000E 02,
 CEND   =  0.0000000E 00, CFTD   =  1.0000000E 00, CGMAN  =  1.6600000E 04, CGRMAN=  1.6600000E 04,
 CI     =  0.0000000E 00, CII    =  0.0000000E 00, CKIT   =  1.1100000E 02, CKMD   =  8.4999996E-01,
 CKMI   =  8.4999996E-01, CKMO   =  8.4999996E-01, CKPD   =  8.4999996E-01, CKPI   =  8.4999996E-01,
 CKPO   =  8.4999996E-01, CKUD   =  8.4999996E-01, CKUE   =  0.0000000E 00, CKUI   =  8.4999996E-01,
 CKUO   =  8.4999996E-01, CLRUPG=  0.0000000E 00, CMUDPG=  0.0000000E 00, CMP    =  4.5000000E 02,
 CONMAN=  0.0000000E 00, CONTCT=  0.0000000E 00, CPE    =  0.0000000E 00, CPI    =  0.0000000E 00,
 CPII   =  0.0000000E 00, CPP    =  0.0000000E 00, CPUBII=  0.0000000E 00, CRI    =  0.0000000E 00,
 CRII   =  0.0000000E 00, CRM    =  8.3500000E 02, CRP    =  8.3500000E 02, CRU    =  8.3500000E 02,
 CSDEP  =  9.9999964E-02, CSDSU  =  0.0000000E 00, CSGSU  =  0.0000000E 00, CTCPUB=  0.0000000E 00,
 CTRA   =  2.3500000E 03, CTRCAL=  0.0000000E 00, CTRI   =  0.0000000E 00, CTRII  =  0.0000000E 00,
 CTRSPT=  0.0000000E 00, CUBEM  =  9.9999979E-03, CUBEP  =  0.0000000E 00, CUBEU  =  9.9999964E-02,
 CUCE   =  0.0000000E 00, CUP    =  7.4100000E 02, DADQL  =  9.7999996E-01, DD     =  1.0000000E 00,
 DDS    =  1.0000000E 00, DI     =  4.0000000E 00, DIS    =  4.0000000E 00, E      =  4.9999984E-04,
 ED     =  4.0000000E 01, EDS    =  4.0000000E 01, EE     =  1.0000000E 00, EVDM   =  1.0000000E 00,
 EVDR   =  1.0000000E 00, EVDT   =  0.0000000E 00, EVIM   =  1.0000000E 00, EVIR   =  1.0000000E 00,
 EVIT   =  0.0000000E 00, EVOM   =  1.0000000E 00, EVOR   =  0.0000000E 00, EVOT   =  0.0000000E 00,
 FI     =  9.9999964E-02, FII    =  9.9999964E-02, FINT   =  0.0000000E 00, FMD    =  1.0000000E 00,
 FMI    =  1.0000000E 00, FMO    =  1.0000000E 00, FN     =  0.0000000E 00, FNGF   =  1.9999999E-01,
 FNSP   =  5.0000000E-01, FSA    =  0.0000000E 00, FTI    =  0.0000000E 00, FTII   =  0.0000000E 00,
 FTM    =  3.0000000E 01, FTP    =  1.2000000E 01, FTU    =  5.6000000E 01, FUD    =  1.0000000E 00,
 FUI    =  1.0000000E 00, FUO    =  1.0000000E 00, HPM    =  3.0000000E 01, HPP    =  3.0000000E 01,
 HPU    =  3.0000000E 01, OD     =  4.0000000E 00, ODS    =  4.0000000E 00, OTF    =  5.4799996E-02,
 P      =  2.0000000E 00, PMR    =  0.0000000E 00, PP     =  0.0000000E 00, PPR    =  0.0000000E 00,
 PUR    =  0.0000000E 00, QMM    =  5.0000000E 01, QMP    =  1.0000000E 02, QMU    =  2.0000000E 01,
 QTD    =  0.0000000E 00, QTE    =  0.0000000E 00, QTI    =  0.0000000E 00, QTMD   =  0.0000000E 00,
 QTMI   =  0.0000000E 00, QTMO   =  0.0000000E 00, QTO    =  0.0000000E 00, QTPD   =  0.0000000E 00,
 QTPI   =  0.0000000E 00, QTPO   =  0.0000000E 00, RDD    =  3.0000000E 01, REPEAT=  1.0000000E 00,
 RID    =  3.0000000E 01, RDI    =  1.7000000E 01, SMD    =  0.0000000E 00, SMF    =  0.0000000E 00,
 SMI    =  0.0000000E 00, SMO    =  0.0000000E 00, SPE    =  0.0000000E 00, SPEV   =  1.0000000E 00,
 SPEVR  =  1.0000000E 00, SUD    =  0.0000000E 00, SUI    =  0.0000000E 00, SUO    =  0.0000000E 00,
 SVE    =  0.0000000E 00, SVR    =  0.0000000E 00, SVT    =  0.0000000E 00, SVV    =  0.0000000E 00,
 TALMAN=  0.0000000E 00, TATE   =  3.0000000E 00, TC     =  0.0000000E 00, TD     =  2.5000000E-01,
 TDI    =  3.0000000E 01, TDMAN  =  2.0000000E 00, TDMW   =  5.0000000E-01, TDPMI  =  2.0000000E 00,
 TDPMII=  2.0000000E 00, TDPRI  =  2.0000000E 00, TDPRII=  2.0000000E 00, TDR    =  5.0000000E-01,
 TDRMAN=  2.0000000E 00, TED    =  0.0000000E 00, TF     =  0.0000000E 00, TFR    =  0.0000000E 00,
 TGMAN  =  2.0000000E 00, TGRMAN=  2.0000000E 00, TI     =  2.5000000E-01, TID    =  3.0000000E 01,
 TIMW   =  5.0000000E-01, TIO    =  1.7000000E 01, TIR    =  5.0000000E-01, TMD    =  0.0000000E 00,
 TMOD   =  1.0000000E 00, TMDR   =  0.0000000E 00, TMI    =  0.0000000E 00, TMID   =  1.0000000E 00,
 TMIR   =  0.0000000E 00, TMO    =  0.0000000E 00, TMOD   =  0.0000000E 00, TMOR   =  0.0000000E 00,
 TUE    =  2.0000000E 00, TOI    =  0.0000000E 00, TOMW   =  0.0000000E 00, TONMAN=  0.0000000E 00,
 TRC    =  1.0000000E 00, TUMD   =  3.3600000E 02, TUMI   =  0.0000000E 00, TUMO   =  0.0000000E 00,
 WD     =  1.0000000E 02, WDM    =  4.0000000E 01, WDR    =  4.0000000E 01, WI     =  1.0000000E 02,
 WIM    =  4.0000000E 01, WIR    =  4.0000000E 01, WM     =  5.0000000E-01, WO     =  1.0000000E 02,
 WOM    =  4.0000000E 01, WOR    =  4.0000000E 01, WP     =  0.0000000E 00, WTKIT  =  1.0000000E 00,
 WU     =  3.0000000E 00, YAT    =  0.0000000E 00, YD     =  1.0000000E 00, YMWD   =  1.9999999E-01,
 YP     =  1.0000000E 00, YR     =  1.0000000E 01, YZ     = -1.5000000E 00, ZFL    =  9.9998999E-01,
 ZI     =  0.0000000E 00, ZO     =  0.0000000E 00, EACAL  =  0.0000000E 00, EACSP  =  0.0000000E 00,
 ETI    =  0.0000000E 00, ETII   =  0.0000000E 00, GA     =  0.0000000E 00, GB     =  0.0000000E 00,
 GD     =  0.0000000E 00, GE     =  0.0000000E 00, GF     =  0.0000000E 00, GG     =  0.0000000E 00,
 GH     =  0.0000000E 00, GL     =  0.0000000E 00, GM     =  0.0000000E 00, GN     =  0.0000000E 00,
 GO     =  0.0000000E 00, GP     =  0.0000000E 00, GQ     =  0.0000000E 00, GR     =  0.0000000E 00,
 GS     =  0.0000000E 00, GT     =  1.0000000E 00, H      =  1.0000000E 00,    1.0000000E 00,    1.0000000E 00,
           1.0000000E 00, ID     =              2, INHIB  =              0, IPAGE  =            -15,
 IS     =              3, ITR    =              0, JTED   =              2, NA     =              4,
 NB     =              1, ND     =              1, NU     =              1, OL     =  1.5000000E 01,    1.5000000E 01,
           3.0000000E 01, OST    =  1.5000000E 01,    1.5000000E 01,    2.0000000E 01, SL     =  1.5000000E 01,
           1.5000000E 01,    3.0000000E 01, TAT    =  1.5000000E 01,    3.0000000E 01,    1.2700000E 02,
 TAYZ   =  1.0000000E 00,    1.0000000E 00,    0.0000000E 00,    0.0000000E 00,    0.0000000E 00,    0.0000000E 00,
           0.0000000E 00,    0.0000000E 00,    0.0000000E 00,    0.0000000E 00, ZM     =  9.9998999E-01,    9.9998999E-01,
           9.9998999E-01, ZP     =  9.9998999E-01,    9.9998999E-01,    9.9998999E-01, ZU     =  5.0000000E-01,
```

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TABLE 12. NAMELIST/LL/PRINTOUT

```
&LL
 E      =  4.9999984E-04,  DTF    =  5.4799996E-02,  CUP    =  7.4100000E 02,  CMP    =  4.5000000E 02,
 CPP    =  0.0000000E 00,  CEND   =  0.0000000E 00,  CPE    =  0.0000000E 00,  WU     =  3.0000000E 00,
 WM     =  5.0000000E-01,  WP     =  0.0000000E 00,  CUBEU  =  9.9999964E-02,  CUBEM  =  9.9999979E-03,
 CUBEP  =  0.0000000E 00,  EE     =  1.0000000E 00,  REPEAT=  1.0000000E 00,  P      =  2.0000000E 00,
 PP     =  0.0000000E 00,  TC     =  0.0000000E 00,  TF     =  0.0000000E 00,  TFR    =  0.0000000E 00,
 TMO    =  0.0000000E 00,  TMUR   =  0.0000000E 00,  TI     =  2.5000000E-01,  TIR    =  5.0000000E-01,
 TMI    =  0.0000000E 00,  TMIP   =  0.0000000E 00,  TD     =  2.5000000E-01,  TDR    =  5.0000000E-01,
 TMD    =  0.0000000E 00,  TMDP   =  0.0000000E 00,  YMWO   =  1.9999999E-01,  TAYZ   =  1.0000000E 00,  1.0000000E 00,
           0.0000000E 00,    0.0000000E 00,    0.0000000E 00,  0.0000000E 00,    0.0000000E 00,    0.0000000E 00,
           0.0000000E 00,    0.0000000E 00,  AYZP =   1.0000000E 00,  SPE    =    0.0000000E 00,  SPEV  =   1.0000000E 00,
 SPEVR  =  1.0000000E 00,  ETI    =  0.0000000E 00,  ETII   =  0.0000000E 00,  JTED   =            2,
 DAJQL  =  9.7999996E-01,  CRU    =  8.3500000E 02,  CEN    =  1.0770000E 03,  CAD    =  4.3600000E 02,
 TRC    =  1.0000000E 00,  TOE    =  2.0000000E 00,  FTII   =  0.0000000E 00,  CPI    =  0.0000000E 00,
 CRI    =  0.0000000E 00,  CPII   =  0.0000000E 00,  CRII   =  0.0000000E 00,  CLRUPG=  0.0000000E 00,
 CMODPG=  0.0000000E 00,  CPUBII=  0.0000000E 00
&END
```


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	GA	GB	GD	GE	GF	GG	GH	GL	GM	GN	GO	GP	GQ	GR	GS	GT
1CLASS 1 LRU NO. 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
2CLASS 1 LRU NO. 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
3CLASS 1 LRU NO. 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
4CLASS 1 LRU NO. 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
5CLASS 2 LRU NO. 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.850	.150
6CLASS 2 LRU NO. 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.850	.150
7CLASS 2 LRU NO. 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.850	.150
8CLASS 2 LRU NO. 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.850	.150
9CLASS 2 LRU NO. 5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.850	.150
10CLASS 3 LRU NO. 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.700	.300
11CLASS 3 LRU NO. 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.700	.300
12CLASS 1 LRU NO. 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
13CLASS 1 LRU NO. 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
14CLASS 1 LRU NO. 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
15CLASS 1 LRU NO. 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
16CLASS 2 LRU NO. 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.850	.150
17CLASS 2 LRU NO. 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.850	.150
18CLASS 2 LRU NO. 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.850	.150
19CLASS 2 LRU NO. 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.850	.150
20CLASS 2 LRU NO. 5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.850	.150
21CLASS 3 LRU NO. 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
22CLASS 3 LRU NO. 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

	ETI	ETII	EACSP	EACAL	IS	JTED	NA	NU	IO	AVZP
1CLASS 1 LRU NO. 1	0.	0.	0.	0.	3	2	4	1	0	1.00
2CLASS 1 LRU NO. 2	0.	0.	0.	0.	3	2	4	1	0	1.00
3CLASS 1 LRU NO. 3	0.	0.	0.	0.	3	2	4	1	0	1.00
4CLASS 1 LRU NO. 4	0.	0.	0.	0.	3	2	4	1	0	1.00
5CLASS 2 LRU NO. 1	0.	0.	0.	0.	3	2	4	1	0	1.00
6CLASS 2 LRU NO. 2	0.	0.	0.	0.	3	2	4	1	0	1.00
7CLASS 2 LRU NO. 3	0.	0.	0.	0.	3	2	4	1	0	1.00
8CLASS 2 LRU NO. 4	0.	0.	0.	0.	3	2	4	1	0	1.00
9CLASS 2 LRU NO. 5	1.	0.	0.	0.	3	2	4	1	0	1.00
10CLASS 3 LRU NO. 1	0.	0.	0.	0.	3	2	4	1	0	1.00
11CLASS 3 LRU NO. 2	1.	1.	1.	1.	1	2	4	-1	0	1.00
12CLASS 1 LRU NO. 1	0.	0.	0.	0.	3	2	4	1	0	1.00
13CLASS 1 LRU NO. 2	0.	0.	0.	0.	3	2	4	1	0	1.00
14CLASS 1 LRU NO. 3	0.	0.	0.	0.	3	2	4	1	0	1.00
15CLASS 1 LRU NO. 4	0.	0.	0.	0.	3	2	4	1	0	1.00
16CLASS 2 LRU NO. 1	0.	0.	0.	0.	3	2	4	1	0	1.00
17CLASS 2 LRU NO. 2	0.	0.	0.	0.	3	2	4	1	0	1.00
18CLASS 2 LRU NO. 3	0.	0.	0.	0.	3	2	4	1	0	1.00
19CLASS 2 LRU NO. 4	0.	0.	0.	0.	3	2	4	1	0	1.00
20CLASS 2 LRU NO. 5	1.	0.	0.	0.	3	2	4	1	0	1.00
21CLASS 3 LRU NO. 1	0.	0.	0.	0.	3	2	4	1	0	1.00
22CLASS 3 LRU NO. 2	1.	1.	1.	0.	1	2	4	-3	3	1.00

	FUO	FUI	FUD	FMO	FMI	FMD	SUO	SUI	SUD	SMC	SMI	SMC	ZO	ZI	DAOOL
1CLASS 1 LRU NO. 1	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.98
2CLASS 1 LRU NO. 2	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.98
3CLASS 1 LRU NO. 3	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.98
4CLASS 1 LRU NO. 4	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.98
5CLASS 2 LRU NO. 1	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.50	.98
6CLASS 2 LRU NO. 2	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.50	.98
7CLASS 2 LRU NO. 3	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.50	.98
8CLASS 2 LRU NO. 4	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.50	.98
9CLASS 2 LRU NO. 5	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.50	.98
10CLASS 3 LRU NO. 1	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.70	.98
11CLASS 3 LRU NO. 2	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.70	.98
12CLASS 1 LRU NO. 1	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.98
13CLASS 1 LRU NO. 2	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.98
14CLASS 1 LRU NO. 3	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.98
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure 35. Selected sample of LOCAM 4 printout format for listing of sequence of input data.

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results of these analyses. The commonly used methods (and easiest) are the data table and bar graph or histogram methods.* Table 13 illustrates the data table approach for a USAREUR deployment where the cost elements have been broken down to two cases by the following:

a) Ten-year operations.

b) Initial provision investment.

c) Test equipment acquisition.

d) Test equipment development.

The data shown can be used to substantiate logistics support decisions, because they clearly indicate the lowest cost support alternative and show a breakdown of the significant elements contributing to support costs.

Another way of presenting the same information is the use of the bar graph as shown in Figure 36 to provide a pictorial presentation. The operational availability can also be included in this presentation as shown to provide a comparison on the basis of cost and effectiveness. The bar graph also gives visibility of the cost elements designated as segments A, B, C, and D. Segment A represents a summary breakdown of the ten-year operating cost elements. Segments B, C, and D summarize the elements which comprise nonrecurring costs.

9.2.2 Test Equipment Utilization and Manpower Reporting. The LOCAM 5 model computes the service channel utilization for each item requiring checkout and repair as a fraction of real time. As an option in the program, manpower requirements adjusted for suitable productivity factors can be accounted for on an expected value basis. For manpower computations, reporting can encompass:

a) Manpower productivity.

b) Slack time (waiting for repair items, test accessories, etc.).

c) Test station availability and other contingency operations.

Table 14 is an example of test equipment utilization and manpower reporting in the data table format. The service channel utilization is given in terms of the cumulative hours per day spent at the various test and repair locations. The number of men per site and total manpower for all sites is also indicated for each of the support alternatives studied.

9.2.3 Sensitivity Results Reporting. LOCAM 5 has a built-in variation of parameters capability called sensitivity (Section 7) which is particularly useful in the rapid evaluation of tradeoffs where few "hard" data are available or where the analyst has low confidence in his data.

*Op. Cit., Users Manual for MICOM Program LOCAM 3

TABLE 13. EXAMPLE OF DATA TABLE REPORTING ($ IN THOUSANDS)

			Case I	Case II
(A) 10-Year Operating Costs	Maintenance Manpower	Field	352	-
		Depot	329	1,202
	Test Equipment Maintenance		340	251
	Supply Material		8,267	9,412
	Inventory Management		1,188	1,188
	Order, Store, Ship and Handle		138	324
	Subtotal		10,614	12,377
(B) Initial Provision Investment	Line Replaceable Units		6,272	11,866
	Modules/Parts		642	253
	Cost To Enter		294	294
	Subtotal		7,208	12,413
(C) Test Equipment Acquisition	IDSM Test Sets		1,000	1,111
	DS Test Sets		263	-
	GS Test Sets			
	Depot Test Stations		264	220
	Subtotal		1,747	1,220
(D) Test Equipment Development	IDSM Test Sets		425	425
	DS Test Sets		1,824	-
	Depot/GS Test Stations		1,370	3,285
	Subtotal		3,619	3,619
Total Support Costs			23,188	29,720

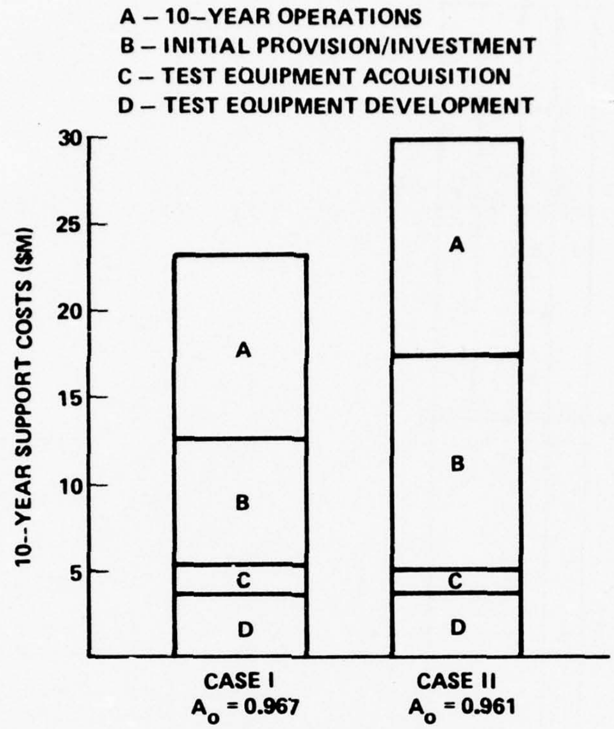

Figure 36. Example of bar graph reporting.

The results obtained from sensitivity testing may be used to construct graphs which display the behavior of the maintenance concept over the range of input parameters. Such graphs provide insight into the problems being investigated and help the analyst to determine which input parameters are critical to his application. That is, sensitivity may show that wide variation of some of the input parameters, among them perhaps his low confidence data, makes little or no difference in his result. Sensitivity will also help him to know which of his input parameters are very important and therefore need further investigation to refine or substantiate his input values.

The factors which influence workload such as maintenance incident rate, the number of deployed systems or prime equipment utilization are generally prime candidates for investigations of support cost sensitivity. Other investigations might include the effect of increasing or decreasing the modification workload, present value theory effect, or the generation of data to make comparisons of the basis of equal effectiveness (availability).

9.2.3.1 <u>Examples of the Influence of Workload on Support Costs</u>. Figure 37 was prepared from the results obtained for sensitivity test

TABLE 14. SAMPLE TEST AND REPAIR CHANNEL UTILIZATION AND MANPOWER REQUIREMENTS DATA TABLE

	DS Site				GS Site				Depot			
	Test Time (hr/day)	No. of Test Men	Repair Time (hr/day)	No. of Repair Men	Test Time (hr/day)	No. of Test Men	Repair Time (hr/day)	No. of Repair Men	Test Time (hr/day)	No. of Test Men	Repair Time (hr/day)	No. of Repair Men
Case I	1.54	0.39	1.69	0.42	0.63	0.16	0.86	0.47	3.01	0.75	5.02	1.26
Number Men Per Site	0.81				0.63				2.01			
Total Manpower	1.62				0.63				2.01			
Case II									8.66	2.17	10.24	2.56
Number of Men Per Site									4.73			
Total Manpower									4.73			

runs that were made along with the baseline USAREUR and CONUS runs.* At the baseline reference point (maintenance incident rate multiple = 1), the support costs are shown as the total support costs for Cases I and II. The results shown in Figure 37 indicate the support cost trends as the maintenance incident rate increases or decreases about the baseline value.

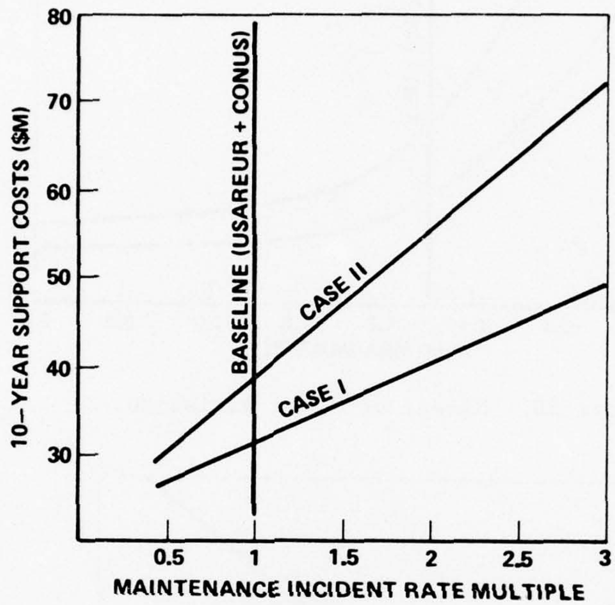

Figure 37. Effect of maintenance incidence rate variation.

Another way of viewing the same result is to plot support costs versus the inverse of maintenance incident rate. This was done to obtain the results shown in Figure 38 which plots the support costs versus In Figure 38, there are curves which display the characteristic "knee" as time between maintenance increases. Sensitivity testing can also be used to investigate the effect of simultaneous variations of more than one input variable. This feature was used to obtain the result presented in Figure 39. Here the effect of varying maintenance incident rate is shown whicle at the same time the number of deplyed systems is doubled.

9.2.3.2 <u>Present Value Sensitivity Effects</u>. Sensitivity testing may also be used to show costs in relation to present value (inflation or discounting). The aspect of discounting refers to the application of a selected rate of interest to measure the differences in importance

*Ibid.

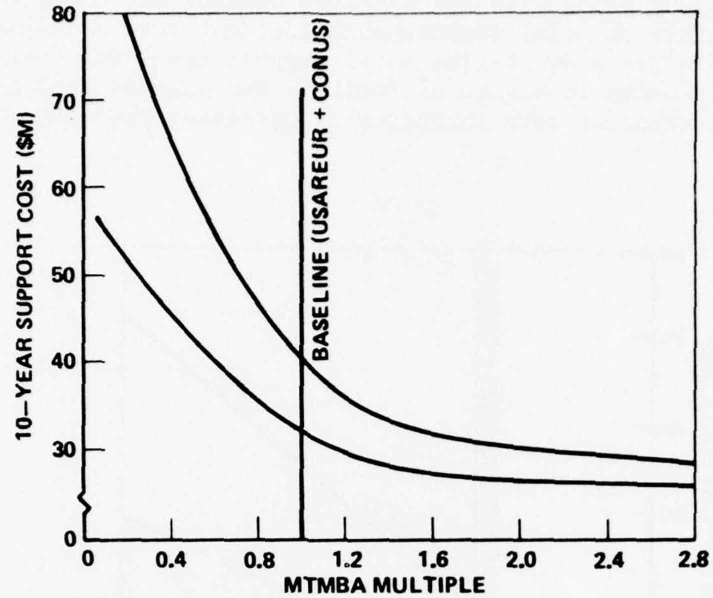

Figure 38. Effect of MTBMA variation.

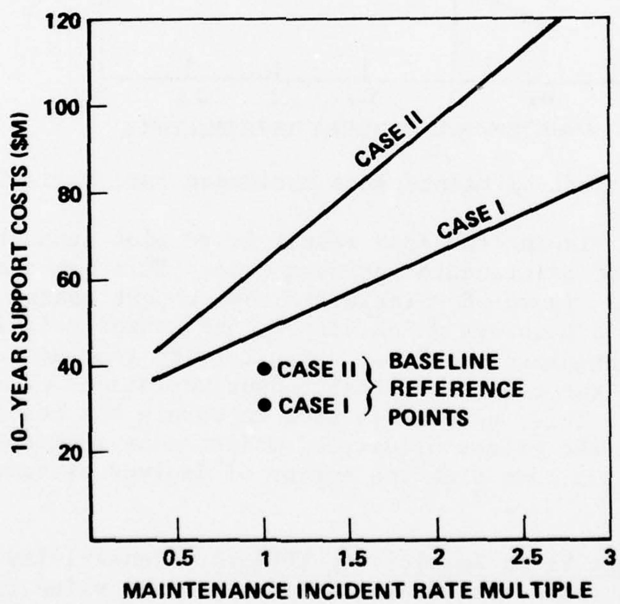

Figure 39. Effect of simultaneous variation of maintenance incident rate and doubling the number of deployed systems.

or preference between dollars at present time or anticipated dollars in the future. For the result shown in Figure 40, the yearly interest rate, FINT, was input negatively (inflation) and positively (discounting) around the center value of FINT = 0. The present value expressions are contained within the basic LOCAM 4 formulation and were activated by inputting FINT as the sensitivity test input variable (definition for FINT in Appendix B).

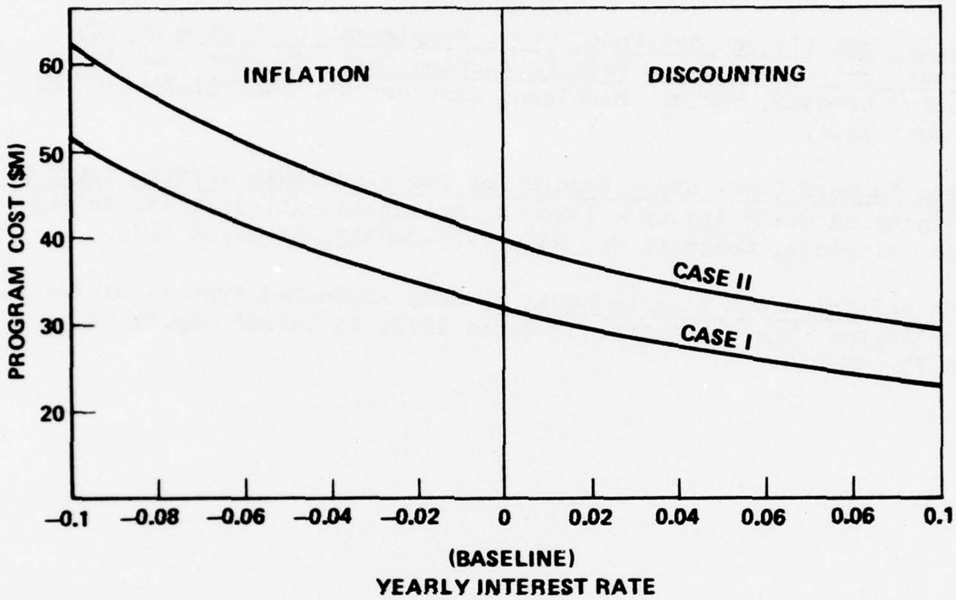

Figure 40. Sensitivity run showing present value theory effects.

SECTION 10
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Logistics Support Costs Study Report for Two Electronic Warfare Systems, US Army Security Agency - IALOG-R, Arlington Hall Station, Arlington, Virginia, Contract No. DAHC07-75-C-0332, 31 March 1976.

Users Manual for MICOM Program LOCAM 3, RCA, Automated Systems Division, Burlington, Massachusetts, 30 March 1973, Technical Report No. CR 73-588-010.

Appendix A. DEFINITION OF OUTPUT AND OTHER SYMBOLS USED

AAIE	An internal control whose value may = 1.0 or 0.0 only. Value set by input value of JTED (Appendix B) to govern computations of Type I and/or Type II test equipment (and repair) loading.
ATE	Automatic Test Equipment.
AMULT	Scale factor for all costs on output listings.
ANLYIS	A nonrecurring identifier signifying the type of analysis or name of analyst on output listings.
CAYZ	System or subsystem operational availability.
CAYZI	System or subsystem inherent availability.
CD	Cost for development of the installed equipment and test equipment plus software (Section 9).
CED	Cost for development of the installed LRUs.
CEP	Cost for procurement of the installed LRUs at all installations.
CET	Subtotal cost of LRUs, includes development procurement and end of life salvage.
CEV	End of life salvage value of the installed LRUs.
CFR	Cost of facility support based on the square footage of floor space at the depot.
CFT	Subtotal facilities cost, same as CFR in LOCAM 5.
CIVP	Cost of initial provisions of LRUs, modules, and parts.
CIVR	Cost of consumed material during O&M phase.
CVIT	Cost of initial provision plus the cost of consumed supplies less salvage value of residual inventory.
CIVV	End of life salvage of residual inventory.
CMPPY	Nonrecurring training costs.
CMPR	Cost of maintenance manpower during O&M phase.

CMPRR	Cost of repair manpower during O&M phase.
CMPT	Subtotal of manpower costs including nonrecurring training.
COSTIS	Narrative description of dollar units (100s, 1000s, etc.).
COU	Check out unit (LRU).
CP	The total acquisition (production) costs (Section 9).
CR	The total cost for operations and maintenance (Section 9).
CROR	Cost of reordering supplies during O&M phase.
CROT	Subtotal cost of reordering supplies, same as CROR in LOCAM 5.
CS	Total end of life salvage value.
CSAP	Cost of retention of items in the inventory for supply administration.
CSAT	Subtotal cost for supply administration.
CSHR	Costs for shipping and handling.
CSHT	Subtotal cost for shipping and handling, same as CSHR in LOCAM 5.
CSVR	Recurring salvage value based on items consumed.
CTSD	Development cost of test equipment.
CTSOFT	Cost of technical data (documentation) or software (programming).
CTSP	Production cost of test equipment.
CTSR	Costs related to test equipment support.
CTST	Subtotal for all test equipment costs.
CTSV	End of life salvage value of test equipment.
CUM	Signifies that the quantity printed on the output listing is cumulative.
CWHR	Cost for storage of materials or supplies.
CWHT	Subtotal cost for storage, same as CWHR in LOCAM 5.

DELTA	Differential between dedicated and expected value manpower.
EACH	Signifies that the quantity printed on the output listing pertains to the individual LRU.
FIM	Fault isolate an LRU to the failed module.
FIP	Fault isolate a module to the failed part.
GCT	Grand cost total for the system over the life cycle.
IA7, IA8	There are mutually exclusive flags (when IA7 = 1, IA8 must be = 0 and vice versa). A value of unity indicates which of the tapes (7 or 8) the summary LRU data may be found on.
ISET, IATE	These are internal flags which control which tape (7 or 8) the summarization process (of LRUs) is to read from and written to tape. If ISET = 1, the program reads from 7, adds data, and writes on 8. If ISET ≠ 1 and IATE = 1, the program reads from 8, adds data, and writes to 7. If both ≠ 1, this is the first pass and LRU data are written on tape 7.
ICN	A counter of LRUs and is compared to NDLRU to determine when the last LRU has been processed.
ILS	Integrated Logistics Support.
KAD	A variable which may have the values 1, 7, 8, or 9 only. The values (except 1) are assigned in the sensitivity section to determine the next starting point. 1 - is a normal start for a new LRU. 7 - restarts the program in the sensitivity section to start the application of new SENSY rules . 8 - restarts the program in the sensitivity section to start another LRU whose values are to be changed per 7. 9 - restarts the program at the beginning after all sensitivity tests have been performed. It permits reading in a completely new set of data.
/L/	NAMELIST - a listing of all LRU inputs (Appendix C).
/LL/	An abbreviated listing of NAMELIST inputs.
LCC	Life cycle costs.
LOCAM	Logistics Cost Analysis Model.

LRU	Line replaceable unit.
MTBF	Mean time between failures.
MTBMA	Mean time between maintenance actions.
MWO	Modification work order.
O&M	Operations and maintenance
ORLA	Optimum repair level analysis.
PVCD	Present value cost for development.
PVCP	Present value cost for production.
PVCR	Present value cost for recurring operations.
PVCS	Present value cost for salvage.
PDELTA	Present value of manpower differential (see DELTA).
PVGCT	Present value of grand cost total.
REMARK	Descriptor to identify qualifying information for the LRU under analysis (Appendix C).
SENSY	The name of the sensitivity testing array (Section 7).
TEXT	The name of the output printout page header information (Appendix C).
TOTAL	Indicates that a summation of each LRU for all theaters/ cases is called (Appendix C).
UNITIS	Descriptor to identify the name ofthe LRU on the output listings (Appendix C).

Functions and Subroutines

BASIC Called twice to compute:

1) Dollar/pound/hour/installation for shipping.
2) Quantity of LRUs, modules, and parts tied up and the number of LRUs out of operation.

SENSIT Records the variables to be altered for the sensitivity pass.

AB	Typical use:
	A = AB(x)
	A = 0. if $x \leq .1 * 10^{-19}$
	Otherwise
	A = 1.
DEF	Called with quantity of stock on hand and the expected value of demand for stock.
	Provides the number of demands that will find no stock.
D	Typical use:
	A = D (x)
	A = x if $x > .1 * 10^{-19}$
	Otherwise
	A = 1.
PAGE	Prints page number, heading (TEXT), DATE, "ANLYIS", UNITIS and REMARK information.
IOL	Computes LRUs, modules, parts to be stocked per LOCAM 5 rules.
SPOL	Typical use: Determines effect of "built-in spares" (FN) and multiple LRUs on availability.

Appendix B. LOCAM INPUT DEFINITIONS

ARA — Annual manpower turnover fraction for test and repair.

AYZP — Control to specify the method for computing the initial provision quantities. It generally is input as a signed whole number as follows:

AYZP = 1. Use MIRADCOM Maintenance Rules.

AYZP = 0. Use LOCAM Supply Rates.

AYZP = -1. Provision quantities are to be input.

AYZP may also contain a fractional part. The absolute value of the fraction is used to control override stock to meet specified availability. The absolute value of the fraction states the fraction of inherent availability to be achieved.

Example

AYZP = 1.0 Use MIRADCOM Maintenance rule. No force on availability.

AYZP = 1.9 Use MIRADCOM Maintenance rule. Force to get 90% of the inherent availability.

AYZP = 0.73 Use LOCAM Supply Rule. Force to get 73% of the inherent availability.

CAD — Cost in dollars per year to retain an item (LRU, module, non-standard part) in the supply system.

CALMAN — Yearly cost in dollars per man for a calibration man.

CALPUB — Cost in dollars for technical data for calibration/Type III test equipment. (CALPUB is set to zero within the program after use.)

CALSET — Number of calibration/Type III test sets and teams.

CCAL — Development cost in dollars for calibration/Type III test equipment. (CCAL is set to zero within the program after use.)

CCALP — Procurement cost in dollars for a calibration/Type III test set.

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LOCAM 5, PROGRAMMER/USER'S MANUAL. VOLUME II.(U)

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CCALR — Yearly cost in dollars to support a calibration/Type III test set.

CCSP — Development cost in dollars for contract support/Type IV test sets. (CCSP is set to zero within the program after use.)

CCSPP — Procurement cost in dollars for a contract support/Type IV test set.

CCSPR — Yearly cost in dollars to support a contract/support/Type IV test set.

CDEO — Shipping from the installation to the Direct Support activity input as dollars per item per pound per trip and is used in the computation of shipping and handling charges.

CDOE — Shipping from Direct to the installation (units as CDEO).

CDOI — Shipping from Direct to General Support (units as CDEO).

CDIO — Shipping from General Support to Direct Support (units as CDEO).

CDID — Shipping General to Depot (units as CDEO).

CDDI — Shipping from Depot to General Support (units as CDEO).

CDFD — Shipping for a one-way trip from a contractor to the Government Depot (units as CDEO). It is applied to shipment of reprocured material.

CDMAN — Yearly cost in dollars for a test man at Direct Support.

CDPMAN — Yearly cost in dollars for a test man at Depot.

CDPRMN — Yearly cost in dollars for a repairman at Depot.

CDRMAN — Yearly cost in dollars of a repairman at Direct Support.

CEN — Cost in dollars to enter a line item into the supply system.

CEND — Development cost in dollars for LRU. (CEND is set to zero within the program after use.)

CFTD — Cost in dollars per square foot/month for floor space at Depot for test equipment.

CGMAN — Yearly cost in dollars for a test equipment man at General Support.

CGRMAN	Yearly cost in dollars of a repairman at General Support.
CI	Development cost in dollars for Type I test equipment. (CI is set to zero within the program after use.)
CII	Development cost in dollars for Type II test equipment. (CII is set to zero within the program after use.)
CKIT	Cost in dollars for a modification kit.
CKMD[1]	Safety stock coefficient for module stock at Depot.
CKMI	Safety stock coefficient for module stock at General Support.
CKMO	Safety stock coefficient for module stock at Direct Support.
CKPD	Safety stock coefficient for part stock at Depot.
CKPI	Safety stock coefficient for part stock at General Support.
CKPO	Safety stock coefficient for part stock at Direct Support.
CKUD	Safety stock coefficient for LRU stock at Depot.
CKUE	Safety stock coefficient for equipment level spare LRUs.
CKUI	Safety stock coefficient for LRU stock at General Support.
CKUO	Safety stock coefficient for LRU stock at Direct Support.
CLRUPG	Cost in dollars to program and provide technical data for Type I test equipment for LRU repair.
CMODPG	Cost in dollars to program and provide technical data for Type I test equipment for module repair for each module type.
CMP	Average cost in dollars for spare or replacement module or chassis mounted part.
CONMAN	Yearly cost in dollars for a man for the contact support team.
CONTCT	Number of contact support sets and teams.

1. The safety stock coefficients are used in computing initial provision quantities when using LOCAM supply rules (AYZP = 0). In this instance, stock computations are based on the sum of the mean demand quantity plus the safety stock coefficient times the square root of the mean demand quantity. This quantity is rounded off according to a rule governed by the fractional values input for the ZU, ZM, and ZP arrays.

CPE	Nonrecurring production or development cost in dollars for an LRU. (CPE is set to zero within the program after use.)
CPI	Acquisition cost in dollars of Type I test set.
CPII	Acquisition cost in dollars of Type II test equipment.
CPP	Average cost in dollars for a spare or replacement part.
CPUBII	Cost in dollars for technical data for Type II test equipment. (CPUBII is set to zero within the program after use.)
CRI	Yearly cost in dollars for materials to support a Type I test station.
CRII	Yearly cost in dollars for materials to support a Type II test station.
CRM	Cost in dollars per module reorder action.
CRP	Cost in dollars per part reorder action.
CRU	Cost in dollars per LRU reorder action.
CSDEP	Cost in dollars per cubic foot per month for material storage at Depot.
CSDSU	Cost in dollars per cubic foot per month for material storage at Direct Support.
GSGSU	Cost in dollars per cubic foot per month for material storage at General Support.
CTCPUB	Cost in dollars for technical data for contact support/Type IV test equipment. (CTCPUB is set at zero within the program after use.)
CTRA	Cost in dollars to train one man.
CTRCAL	Nonrecurring cost in dollars to set up training program for the calibration Type III test equipment teams.
CTRI	Nonrecurring cost in dollars to set up training program for Type I test equipment.
CTRII	Nonrecurring cost in dollars to set up training program for Type II test equipment.
CTRSPT	Nonrecurring cost in dollars to set up training program for the contact support Type IV test equipment.

CUBEM Storage volume in cubic feet for a module.

CUBEP Storage volume in cubic feet for a part.

CUBEU Storage volume in cubic feet for a LRU.

CUCE[2] Cost in dollars per year to provide round-the-clock coverage for equipment level manpower. Used in combination with SMF to model expected value manpower at the equipment level.

CUP Cost in dollars for the LRU under analysis (deployment, replacement, and provision LRUs).

DAOQL Fraction of Depot workload that is good when delivered to the field stockage point. 1-DAOQL is recycled.

DD Number of Depot level maintenance locations.

DDS Number of Depot level supply points.

DI Number of General Support maintenance locations.

DIS Number of General Support supply points.

DTI Number of days delay expected for maintenance turn-around time at General Support. Used to compute pipeline for evacuated LRUs.

DTO Number of days delay expected for maintenance turn-around time at Direct Support. Used to compute pipeline for evacuated LRUs.

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2. SMF and CUCE - "E" Level "Manpower" - LOCAM 5 includes an equation for the computation of expected value of manpower at the equipment level (CMANE) in addition to the provisions of the model for the computation of integer values of contact support manpower using inputs CONMAN, TONMAN, CONTCT, etc. (both methods may be used simultaneously when desired).

Input CUCE is the cost in dollars per year per equipment level team where a team means the number of men to give the required round-the-clock coverage as needed in the problem at hand. For example, if two men are needed to work together on any given problem and round-the-clock coverage requires four such sets of two men, then CUCE is the cost per year for eight men and should include any associated burden costs.

The cost for these men will be based on the unscheduled maintenance rate for the equipment plus the fraction of the operation time fraction, OTF, during which scheduled maintenance is required. Input SMF is the schedule maintenance fraction. (This can also be interpreted as a scheduled manning fraction to represent operators.)

E Failure rate per operating hour.

EACAL Controls posting out one time costs for calibration/Type III test channels including manpower. Only the values zero and unity are permitted.

EACAL = 0 no posting of costs.

EACAL = 1 forces the posting of costs.

EACAL is reset to zero after each use.

EACSP Controls posting out one time costs for contact support/Type IV test equipment and manpower. Only the values zero and unity are permitted.

EACSP = 0 no posting of costs.

EACSP = 1 forces the posting of costs.

EACSP is reset to zero after each use.

ED Total number of deployed equipments.

EDS Number of equipment level supply points.

EE The number of identical LRUs per installation.

ETI Controls posting out accumulated work demands at service channels of Type I test equipment and their associated repair positions. Only the values zero and unity are permitted.

ETI = 0 no posting of costs.

ETI = 1 forces the posting of cumulative demand into the cost totals and reset the demand accumulators.

ETI is reset to zero at each program pass.

ETII Controls posting out accumulated work demands for service channels at Depot of Type II test equipment. Only the values zero and unity are permitted.

ETII = 0 no posting of costs.

ETII = 1 Forces the posting of cumulative demand into the cost totals and resets the demand accumulators.

ETII is reset to zero at each program pass.

EVDM[3]	Expected value flag for test equipment manpower at Depot.
EVDR	Expected value flag for repair manpower at Depot.
EVDT	Expected value flag for test equipment at Depot.
EVIM	Expected value flag for test equipment manpower at General Support.
EVIR	Expected value flag for repair manpower at General Support.
EVIT	Expected value flag for test equipment at General Support.
EVOM	Expected value flag for test equipment manpower at Direct Support.
EVOR	Expected value flag for repair manpower at Direct Support.
EVOT	Expected value flag for test equipment at Direct Support.
FI	Fraction of Type I test equipment manpower demand that is added for self-support.
FII	Fraction of Type II test equipment manpower demand that is added for self-support.
FINT[4]	Yearly interest rate used in the computation of present value. It is the net rate between discount rate and inflation rate. Thus, if inflation exceeds discount, FINT may be input negative. Zero input gives net cost output without discount.

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3. Expected value flags may have only the values zero and unity. When set to unity, they give expected value (shared prorata utilization) of the service demand. When set to zero, they give integer round off, as governed by the round off input ZFL.

4. Discounting relates to the time value of money. It refers to the application of a selected rate of interest FINT such that future cost is adjusted to the present time. It also recognizes that a dollar today is worth more than future dollars because of the interest cost that is related to expenditures which occur over time. Discounting is a technique for converting costs occurring over time to equivalent amounts at a common point in time to facilitate comparison of alternative investments. The common point in time is set by the input YZ in LOCAM 5.

FMD[5] Fraction of modules that arrive at Depot that are repaired at Depot. Modules not repaired are scrapped.

FMI Specifies the module repair fraction at General Support.

FMO Specifies the module repair fraction at Direct Support.

FN[6] Number of identical LRUs within a system whose failure does not detract from system availability. Used to model effect of equipment redundancy within the system.

FNGF[7] Number to specify the ratio of false no-go LRU demands to true failures.

FNSP[8] Nonstandard part fraction related to the cost for supply administration.

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5. FMD, FMI, and FMO are module repair fractions. They specify the fraction of modules arriving at Depot, General Support, and Direct Support, respectively, that are repaired at these levels. The work-flow of modules relates to the maintenance policy (G fraction). Modules not repaired at a lower echelon may be sent to a higher echelon if the maintenance policy allows it, otherwise they are scrapped.

6. FN is used in computing availability. It is a statement of the number of permissible failures at an installation before down-time counts. For redundant items, for example, FN = 1. If all failures count, FN = 0. The *availability* computation forgives FN failures, so to speak, before counting down-time. For a given LRU, input EE (a whole number) states the number of times a given LRU is replicated (used) per ED location. Input FN states the number of LRUs within EE whose equipment failure does not detract from system availability. For example, if there are two radio receivers per tank for the sake of redundancy of the system and one receiver out of service is permitted, then EE = 2. andFN = 1. When FN = EE, all LRUs are permitted out of service and the LRU has no role in the system availability. EE and FN must be input as whole real numbers.

7. If FNGF equals unity, the false no-go rate will equal the true failure rate specified by E. In use in the program, FNGF is commutative with the input OTF. Thus OTF modifies the false no-go rate so that it is a real time rate.

8. FNSP is used in all cost calculations related to the cost of parts. FNSP = 1. gives the full cost. FNSP = 0. deletes all cost. Intermediate values act directly. The purpose of FNSP is to reconcile overlap of common parts among different units. (The input PP reconciles commonality of parts within a unit.)

FSA Factor to account for field supply administration cost. Dollars per year per line item type per field supply location.

FTI Number of square feet of space required at Depot for Type I test equipment.

FTII Number of square feet of space required at Depot for Type II test equipment.

FTU Time factor in weeks used in the computation of LRU stock at Depot. FTU is the fixed time cycle associated with LRU reprocurement. Typically, this is the factory start-up time between placement of an order and delivery of the first LRU.

FTM Analogous to FTU but is for module reprocurement.

FTP Analogous to FTU and FTM but is for parts reprocurement.

FUO[9] LRU repair fraction for LRUs arriving at the Direct Support level. LRUs not repaired are sent to the next higher level if specified by a G fraction, otherwise they are scrapped.

FUD LRU repair fraction at Depot. LRUs not repaired at Depot are scrapped.

FUI LRU repair fraction at the General Support level. LRUs repaired are sent to Depot if specified by a G fraction, otherwise they are scrapped.

GA Specifies a policy of discard at failure. There are no maintenance support activities. All failures, false no-go indications, and attrition rate inputs result in LRU discard. Only LRUs are stocked in the supply system. There is no demand for modules or parts.

GB Similar to GA but here is a provision to detect false no-go's at Direct Support and only failed and attrited LRUs are discarded. There is no demand for module or part stock. There is a demand for checkout service at the Direct Support level and the algebra uses Type I test equipment input data for this.

GD Specifies LRU repair at the Direct Support level by removing and replacing a defective module. The defective module is discarded.

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9. FUO, FUI, and FUD are the LRU repair fractions. They specify the fraction of LRUs arriving at Direct Support, General Support, and Depot, respectively, that are repaired at these levels. Like the module repair fraction FMO, FMI, and FMD, the workflow of LRUs relates to the maintenance policy (G fraction).

GE Specifies LRU repair at the General Support level by removing and replacing a defective module. The defective module is discarded.

GF Specifies LRU repair at the General Support level with checkout performed at Direct Support to remove false no-go LRUs before sending the work to General Support. LRU repair is by removal and replacement of a defective module and the defective module is discarded.

GG Specifies LRU repair at Depot. Defective modules are discarded.

GH Specifies LRU repair at Depot preceded by a checkout at the Direct level to screen false no-go's.

GL Specifies LRU and module repair at the Direct Support level.

GM Specifies LRU repair at Direct Support and module repair at General Support.

GN Specifies LRU repair at Direct Support and module repair at Depot.

GO Specifies checkout to catch false no-go's at Direct Support followed by LRU and module repair at General Support.

GP Specifies checkout to catch false no-go's at Direct Support followed by LRU repair at General Support and module repair at Depot.

GQ Specifies LRU checkout to catch false no-go's at Direct Support followed by LRU and module repair at Depot.

GR Specifies LRU and module repair at the General Support level.

GS Specifies LRU repair at General Support and module repair at Depot.

GT Specifies LRU and module repair at Depot.

In all cases, the term LRU repair includes detection of false no-go items unless it has been preceded by a checkout at the Direct Support level. Also, whenever module repair succeeds LRU repair, any LRUs not repaired at the lower level will also go to the module repair facility for LRU repair. Thus, for example, for GP any LRUs not repaired at the General Support will go to Depot for repair. In all cases, the degree of repair performed at any level either on LRUs or on modules will be set by other input repair fractions. Whenever LRU repair is indicated,

the program computes the module stock required to support LRU repair. Similarly, whenever module repair is indicated, the program computes the part stock required to perform module repair. Parts are always non-repairable and are discarded.

The specification of maintenance concept is accomplished by input of the GA through GT fractions. They may be mixed in any proportion summing to unity to represent the flow of the components of work demand. For example, if the following are input as the maintenance concept for a particular LRU:

GL = 0.6, GR = 0.25, GT = 0.15

Then, 60% of the LRU removals would be sent to Direct Support for repair, 25% would be sent to General Support for repair, and the remaining 15% would go to Depot. In all cases, depending on the repair fraction, units are repaired by removing and replacing defective modules and the failed modules are repaired by removing and replacing defective parts which are discarded.

H[10] An array of dimension four to specify authorized LRU supply locations.

---

10. LOCAM 5 permits four levels of LRU supply. In the program these are the equipment, Direct, General, and Depot support locations. Array H is used to specify for each level whether or not LRU spares are permitted. Any combination from no supply locations to all four is permitted. Array H has dimension four. The first element is for the E level. The second element is for the Direct Support level. The third element is for the General Support level. The fourth element is for the Depot level.

Value zero means stock not authorized. Value unity means "yes" stock is authorized. Only values zero or unity are to be used.

H is input via NAMELIST/L/. Typically,

H = 0., 3*1.,

allows LRU supply at Direct Support, General Support, and Depot levels only. The input

H = 1., 3*0.,

allows LRU spares at the equipment (E level) and denies them to the Direct Support, General Support, and Depot levels.

The program will inspect the inputs QTE, QTO, QTI, and QTD to see if stock quantities have been input. If they have been input, the corresponding H element will be set to unity even if input as zero. This change to H, if made, is permanent until H is again input with some subsequent LRU.

HPM Discretionary procurement holding time in days for modules.

HPP Discretionary procurement holding time in days for parts.

HPU Discretionary procurement holding time in days for LRUs. No safety stock is applied to HPU, HPM, HPP, because it is a discretionary factor and may be waived if earlier procurement is indicated by field experience.

INHIB An integer to control the printout of individual LRU output. Only the numbers 0 and 1 are permitted. INHIB = 0 prints the LRU output page. INHIB = 1 inhibits the printout of LRU output.

IO An integer to control printout of the input namelist data.

IO = 0 Inhibits namelist printout.

IO = 1 Abbreviated namelist is printed.

IO = 2 Program will print all variables in the namelist.

IO = 3 Entire sequence of input data for all LRUs printed out.

IS An integer to control reset functions for maintenance concept fractions, case total accumulators, availability accumulators, workload accumulators, and recall of saved input values.

IS = 1 Anticipatory control for the next LRU. All inputs used for the first LRU of the deck are recalled for use with next LRU plus any input values keypunched for that LRU.

IS = 1 also resets availability and workload accumulators and case total accumulators.

IS ≠ 2 Resets maintenance concept fractions.

IS = 2 Retains maintenance concept fraction from one LRU to the next.

IS = 3 Neutralizes all reset actions. It must be set to 3 in the first LRU data block to assure correct accumulator function (Program flow chart).

IPAGE An integral control for assigning the number of first page of output printout.

JTED An integer control used to designate the type and location of test equipment.

JTED = 1 permits location of Type I test equipment at the Direct Support, General Support, and Depot sites.

JTED = 2 permits location of Type I test equipment as in JTED = 1 and Type II test equipment at Depot.

NA[11] An integer to control the number of system availability modes to be tallied for the case being run.

NB[12] An integer to control initialization of default values.

NU An integer to control printout of case totals and grand totals pages, reset the grand total accumulators and provide the means for apositive program stop.

NU = 0 Suppresses print of totals page.

NU = -1 Prints the case totals page. This value may be used at any time to examine the contents of the totals accumulators. The printout of the case totals page is not accompanied by any change in the accumulators or any other program variable.

NU = -2 Prints the case totals page as for NU = -1 and also prints a grand totals page following the case totals page. Reset of the case total accumulators is accomplished by the control IS. IS is input with the last LRU in a case deployment as IS = 1 to accomplish the reset of the case total accumulators after printout of the case totals pages.

NU = -3 Provides the same function as NU = -2, - i.e., it prints out both the case total and the grand total pages. Additionally, it resets the grand total accumulators.

NY = -4 Provides a positive program stop; used in combination with a dummy REMARK card and a dummy UNITS card followed by a NAMELIST card with NU = -4.

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11. NA is used in combination with the input TAYZ (the availability tally control). In LOCAM 5, there are ten availability accumulators; therefore, it is possible to take up to ten availability products for different sets of LRUs. NA is the input which specifies how many of the ten accumulators are active.

12. In LOCAM 5, all program inputs obtain initial values in a BLOCK DATA subprogram. All inputs are stored in an array immediately after the read of input data for the first LRU either from BLOCK DATA or NAMELIST/L/. Input of IS = 1 with one LRU recalls the list of saved values prior to the read of the next LRU. Thus, the set of inputs for the first LRU including the standard values not input via NAMELIST/L/ become the "reset" standard values. These "reset" standard values may be redefined at any time throughout the program by use of the control NB. NB is in namelist L and may be input with any LRU. The exact value NB = 0 (an integer) will force the storing of the current data set for that LRU as the new set of "reset" values. NB is set to 1 during this storing and the input need not be turned off by the user.

OD Number of Direct Support maintenance locations.

ODS Number of Direct Support supply or stock transfer points.

OL[13] An array of dimension three representing the operating level of supply in days for consumables at Direct, General, and Depot supply points.

QST[13] An array of dimension three representing the order and ship time in days for Direct, General, and Depot supply points.

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13. LOCAM 4 (Reference 2) added a new set of provisioning rules to the LOCAM program called "MICOM maintenance rules." New inputs were introduced to accommodate these rules (OL, OST, SL, TAT, and TATE). For LOCAM 5, three more inputs have been added (DTI, DTO, and STAT) to complete the compliment of required inputs as defined by MIRADCOM. Two of the MIRADCOM maintenance rule inputs were defined previously. The others are defined in their alphabetical order in this Appendix. The input AYZP = 1 activates the use of the MIRADCOM maintenance rules. When using the MIRADCOM maintenance rules, four maintenance turn-around times are provided:

TATE - Used for LRU "E" stock

TAT - Array of dimension three used for LRU stock at General Support, Direct Support, and Depot, respectively.

TATE and TAT are input in days. According to Array H setting authorized supply points, the contents of the repairable pipelines are computed using these maintenance turn-around times. Consumables are supplied according to the Operating Level (OL), Safety Level (SL), and Order Ship Times (OST). (The last is also used at the Depot level for repairables.)

OL, SL, and OST are arrays of dimension three. The order of each array designates the days of supply allowance for Direct Support, General Support, and Depot, respectively. The total content of the repairable and consumable pipelines is computed for LRUs, modules, and parts.

The program attempts to pass this quantity out to the authorized supply points beginning with the forwardmost location. It integerizes at each location using the round-off rules. After each point, a test is made to see if the entire demand has been equaled or exceeded. If it has been met, no further quantities are computed. This prevents oversupply of stock on top of stock. The concept is that all stock is under the control of the NICP and that stock will be directed to where needed from where stocked.

Note that when the MIRADCOM rules are being used to compute the initial provision, the older LOCAM inputs TEO, TOE, TOI, TIO, etc.

pipeline times are being used for the computation of availability. These times specify the "down-time" consequence of a stock outage. The time should be the maximum time, as the model will adjust the time for the fullness of the pipeline.

Thus, TATE, TAT, OL, SL, OST, STAT, DTI, and DTO never enter directly into the availability calculation. The effect of these times is the computation of an integer number of spares. The number of spares enters into the computation of availability.

In this way the user of the model may input policy times for setting the supply levels and input expedited times for the consequences of supply outage on availability.

For example, if spares are permitted at the E level, TATE will set the number of spares. The sum of TEO and TOE sets the expedited time if there is a spares outage. Thus, TATE might be three days to set the level of supply permitted. But, TEO plus TOE might be twenty-four hours to reflect the getting of an LRU overnight if the authorized spare is not available.

OTF	The fraction of real time that installed equipment operates.
P	Number of module types per LRU.
PP	Number of part types per LRU.
PUR PMR PPR	Production rates for LRUs, modules, and parts. These are not normally input because the program overrides the input if the production rates are insufficient to meet the demand and uses a value computed by the program.
QMM	The minimum reorder quantity for modules.
QMP	The minimum reorder quantity for parts.
QMU	The minimum reorder quantity for LRUs.
QTE[14]	Total organization level LRU stock quantity for all EDS locations.

14. QTE, QTO, QTI, QTD, QTMO, QTMI, QTMD, QTPO, QTPI, QTPD – Stock Quantities: In LOCAM 5, these stock quantities may be input as any time regardless of the value of AYZP. LOCAM 5 sets each of these to zero just prior to the read of the input NAMELIST. If any one is input, it will be used as input instead of being computed. It is the responsibility of the user to input values compatible with his concept (GA through GT), - i.e., unless Direct Support is performing repair to the

piece part level, it would be meaningless to input a value for QTPO. However, such an erroneous input would be accepted and used by the program.

After the read of the input NAMELIST, the LRU stock quantities are inspected to see which are non-zero. If any are non-zero and this is inconsistent with the input Array H (Page 198), the corresponding values of Array H are altered. For example, if Array H has been input to prohibit LRU spares at Direct and QTO is input giving LRU spares to Direct, then Array H is permanent until altered by some subsequent input of Array H via NAMELIST with some subsequent LRU. When AYZP has a fractional part to call for a force on availability, the forewardmost LRU stockpile will be increased if necessary to try to meet the specified availability. In the event that the initial quantity for the forewardmost pile has been input, it will be subject to revision upwards.

QTO	Total Direct Support level LRU stock quantity for all ODS locations.
QTI	Total General Support level LRU stock quantity for all DIS locations.
QTD	Total Depot level LRU stock quantity for all DDS locations.
QTMO	Total Direct Support level module stock quantity for all ODS locations.
QTMI	Total General Support level module stock quantity for all DIS locations.
QTMD	Total Depot level module stock quantity for all DDS locations.
QTPO	Total Direct Support level part stock quantity for all ODS locations.
QTPI	Total General Support level part stock quantity for all DIS locations.
QTPD	Total Depot level part stock quantity for all DDS locations.
RDD	Delay time in days between request for an LUR at a maintenance Depot and handling of the request by the supply point used in the computation of availability in reckoning down-time at the Depot.
REPEAT	Multiplier to represent the number of unique LRUs represented by a NAMELIST input data set (REPEAT is set to unity after each read of input data).

RID When using LOCAM supply rules, RID is input in days and is a specification used to distinguish between the supply allowance for condemned modules and parts and the number of days of supply for LRUs and for repaired modules at the General Support level. Within the program, RID is summed with the input TDI to form the term RIDT which sets the days of supply at General Support for condemned modules and parts.

ROI Like RID, ROI is a specification used to distinguish between the supply allowance for condemned module and parts and the number of days of supply for LRUs and for repaired modules at the Direct Support level. Within the program, ROI is summed with the input TIO to form the term ROIT. ROIT sets the days of supply at Direct Support for condemned modules and parts.

SENSY An array organized in the NAMELIST format used to conduct sensitivity runs (Section 7).

SL An array of dimension three representing the safety level days of supply for consumables at Direct, General, and Depot supply points (definition of OL).

SMD[15] The module scrap fraction at the Depot level.

SMI[15] Module scrap fraction at the General Support level.

SMO[15] Module scrap fraction at the Direct Support level.

SMF Scheduled maintenance fraction (CUCE definition).

SPE[16] Fraction for controlling the sunk portion of the prime equipment cost. Any fraction may be used for SPE, SPEV, and SPEVR.

SPE = 0 charges zero (sinks) the cost of the deployed prime equipment.

SPE = 1 changes full cost for deployed equipment.

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15. The scrap fractions SMO, SMI, and SMD are applied to the work flow sent to DS, GS, and Depot by the maintenance policy G fractions prior to any application of the repair fractions FMO, FMI, and FMD. Thus the total module scrap is the flow arriving at a maintenance point times the scrap fraction plus the remainder that are not scrapped but are not repaired as set by the repair fraction (if the latter are not sent on to a higher maintenance level).

16. LOCAM 5 includes equations for the cost of prime equipment CEP, the cost of supply material CIVP, and the cost of consumed material CIVR. The input factors SPE, SPEV, and SPEVR appear in these equations as multipliers. Assigning values to the inputs less than unity,

SPEV[16] Factor to control sinking of cost of the initial provision.

SPEV = 0 no cost for the initial allowance.

SPEV = 1 charges full cost.

SPEVR[16] Factor to sink costs for consumed material.

SPEVR = 0 charges zero cost.

SPEVR = 1 charges full cost.

STAT Shipping turn-around time in days for a LRU from a field maintenance unit to Depot and return.

SUD[17] LRU scrap fraction at Depot.

SUI[17] LRU scrap fraction a General Support level.

SUO[17] LRU scrap fraction at the Direct Support level.

SVE[18] Salvage fraction for cost of installed LRUs at the end of the life of the program.

SVR[18] Salvage fraction for cost of consumed material (reorder stock).

SVT[18] Salvage fraction for cost of test equipment.

SVV[18] Salvage fraction for cost of residual inventory.

TALMAN Number of test men per calibration crew.

TAT An array of dimension three representing maintenance turn-around time at Direct, General, and Depot maintenance points, days (definition for OL).

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16. therefore, reduces the value of the cost equations or in effect sinks some portion of the cost which would otherwise be charged for materials.

17. Module scrap fractions for SMD, SMI, and SMO. The same definitions apply for the LRU scrap fractions; however, it is also noted that the scrap fractions apply only to failure flow and not to false no-go flow.

18. Within the LOCAM 5 program, a salvage computation is made on four types of equipment: installed LRUs, consumed material, test equipment, and residual inventory. The salvage fractions are used as multipliers in functions that are signed negative to reflect the sense of a credit. Thus, the salvage terms are taken as some fraction of the costs for the various types of equipment.

TATE	Maintenance turn-around time in days authorized for LRU equipment level stock for repairables when using MIRADCOM maintenance rules (definition for OL).
TAYZ[19]	An array of dimension ten to specify correspondence between modal availabilities and the LRUs.
TC	Mean test time in hours to checkout an LRU at Direct Support for detection of false no-go LRUs. Used to compute demand for test manpower.
TD	Test time in hours for LRU checkout at Depot. Used to compute demand for test manpower.
TDI	Sums with TID to form variable TIDT which sets the number of days of supply for LRUs and for repaired modules at the General Support level. If stock of LRUs is not designated at General Support, then TIDT sums with TEOT and TOIT in computing downtime in the availability calculations (RID).
TDMAN[20]	Manpower productivity factor or number of men per test crew at Direct Support.

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19. TAYZ is an array of dimension ten to provide the capacity for ten availability accumulators (definition for NA specifies how many of the ten accumulators are active). A value must be entered for each of the ten availability accumulators; however, only the first NA of the ten are actually used. For example, if a system consists of eleven LRUs and if that the system logically subdivides into functional subsystems, the arrangement of the LRUs in the input tray should be such that the first four LRUs constitute the first subsystem, the next five constitute the second subsystem, and the last two constitute the third subsystem. Then if the user wanted to keep the availability tally for the total system and also for each subsystem, four tallies are required. He would input NA = 4. For TAYZ, he would input the following:

LRU No.		LRU No.	
1	TAYZ = 1., 1., 8*0.,	5	TAYZ = 1., 0., 1., 7*0.,
2		6	
3		7	
4		8	
		9	
		10	TAYZ = 1., 2*0., 7*1.,
		11	

All LRUs would be tallied into the first accumulator, i.e., the first element of the TAYZ array is unity for every LRU. The first four LRUs would be tallied into the second accumulator, i.e., the second element of TAYZ is unity for the first four LRUs and zero for

TDPMI	Manpower productivity factor or number of men per test equipment crew at Depot (for Type I test equipment).
TDPMII	Manpower productivity factor or number of men per test equipment crew at Depot (for Type II test equipment).
TDPRI	Manpower productivity factor or the number of men per repair crew at Depot for Type I test equipment.
TDPRII	Manpower productivity factor or the number of men per repair crew at Depot for Type II test equipment.
TDR	Repair time in hours to repair an LRU. Used to compute demand at Depot.
TDRMAN	Manpower productivity factor or number of men per test crew at Direct Support.
TEO[21]	Pipelength in hours between equipment level and Direct Support when using LOCAM Supply Rules or expedited time for obtaining a spare when using MIRADCOM Maintenance Rules (definition of OL).

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19. all others. LRUs five through nine would be tallied into the third accumulator, i.e., the third element of TAYZ is unity for these LRUs and not for any others. The last two LRUs will be tallied into the fourth accumulator, i.e., the fourth element of TAYZ is unity for these two and zero for all others. Values of TAYZ beyond the fourth element are immaterial because NA = 4. On the case total page, four availabilities will print across the page. The first will be the system availability. The second will be the availability of the first subsystem. The third will be for the second subsystem. The fourth, and last, will be for the third subsystem.

20. In LOCAM 5, manpower may be input as shared or dedicated according to the value input for the expected value flags (EVDM). When shared manpower is used, the inputs such as TDMAN represent the manpower productivity to account for less than full time utilization of the maintenance manpower. Factors greater than one are input which in effect act as multipliers onthe cost for manpower.

21. When LOCAM supply rules are used (AYZP = 0), TEO is used in conjunction with the input TOE to set the down-time per failure or false no-go or attrited item returned from an installation to Direct Support. (The return may be for repair, supply, or material transfer.) This down time is used to compute one of the terms in the LOCAM availability formulation and as a minimum at least this much down-time is occasioned at each support demand by a unit. It is

TF	Mean time in hours to test an LRU at Direct Support. It is the total time per service action in the test position and it is used to set the demand for test equipment and for test equipment men.
TFR	Repair time in hours for an LRU at Direct Support. Used to compute demand for repair manpower.
TGMAN	Manpower productivity factor or number of repairmen per test crew at General Support.
TGRMAN	Manpower productivity factor or number of repairmen per repair crew at General Support.
TI	Test time in hours for an LRU at General Support. Used to compute demand for test manpower.
TID	Sums with TDI to form variable TIDT which sets the number of days of supply for LRUs and for repaired modules at the General Support level. If stock or LRUs is not designated at General Support, then TIDT sums with TEOT and TOIT in computing down-time in the availability calculations (RID).
TIO	Sums with TOI to make the variable TOIT, TOIT states the number of days of supply at Direct Support for LRUs (repaired or condemned) and modules which will be repaired. If LRU stock is not designated at Direct, then TOIT also adds additional down-time to TEOT in the computation of availability (ROI).
TIR	Repair time in hours of an LRU at General Support. Used to compute demand for repair manpower.
TMD	Test time in hours for module checkout at Depot. Used to compute demand for test manpower.
TMDR	Repair time in hours for a module at Depot. Used to compute demand for repair manpower.
TMI	Mean test time in hours for module checkout at General Support. Used to compute demand for test manpower.
TMIR	Repair time in hours for a module at General Support. Used to compute demand for repair manpower.

21. the sum of TEO, and TOE that is used in the program; they are never used separately. In particular, TEO might represent the time for a contact support team to go to an installation.

TMO		Mean test time in hours for module checkout at Direct Support. Used to compute demand for test manpower.
TMOD TMID TMDD	Direct General Depot	The time in hours for modification kit installation per repair crew at Direct, General, or Depot.
TMOR		Repair time in hours for a module at Direct Support. Used to compute demand for repair manpower.
TOE		Pipelength between Direct Support and equipment level when using LOCAM Supply Rules, or expedited time for obtaining a spare when using MIRADCOM Maintenance Rules, hours (TEO).
TOI		Sums with TIO to make the variable TOIT, TOIT states the number of days of supply at Direct Support for LRUs (repaired or condemned) and modules which will be repaired. If LRU stock is not designated at Direct, then TOIT also adds additional down-time to TEOT in the computation of availability (ROI).
TONMAN		Number of men per contact support crew (Type IV test equipment).
TOMW TIMW TDMW	Direct General Depot	The mean time in hours spent in the test position (at Direct, General, or Depot) per modification per tests sequence. The program assumes that this time will be spent twice: once before the modification is installed and once after the modification is installed.
TRC		Down-time in hours per service demand at the equipment (equivalent to MTTR).
TUMD		Used in concepts GN, GP, GQ, GS, and GT which call for LRU and module repair at the Depot level. TUMD sets the supply allowance in hours for modules at Depot to cover the time between removal of a module from an LRU until the module is repaired and returned to service for servicing further LRUs.
TUMI		Used in concepts GM, GO, and GR which call for LRU and module repair at the General Support level. TUMI sets the supply allowance in hours for modules at General Support to cover the time between removal of a module from a LRU until the module is repaired and returned to service for servicing further LRUs.
TUMO		Used for maintenance concepts GL where both LRU and module repairs are performed at Direct Support. TUMO sets the supply allowance in hours for modules at Direct Support to cover the time between removal of a module from an LRU until the module is repaired and returned to service for servicing further LRUs.

WD[22] The scheduled work week in hours for test equipment at Depot.

WDM The scheduled work week in hours for test crews at Depot.

WDR The scheduled work week in hours for repair crews at Depot.

WI The scheduled work week in hours for test equipment at General Support.

WIM The scheduled work week in hours for test crews at General Support.

WIR The scheduled work week in hours for repair crews at General Support.

WM The shipping weight in pounds of a module.

WO The scheduled work week in hours for test equipment at Direct Support.

WOM The scheduled work week in hours for test crews at Direct Support.

WOR The scheduled work week in hours for repair crews at Direct Support.

WP The shipping weight in pounds of a part.

WTKIT The shipping weight in pounds of mod kit.

WU The shipping weight in pounds of an LRU.

YAT The annual attrition fraction for LRUs. It represents an annual demand for reissue and reprocurement to replace attrited LRUs. It operates on the population of installed LRUs to determine the number to be replaced each year. Within the program YAT is converted to an hourly attrition rate, A. This, in turn, is multiplied by OTF to get the real time rate.

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22. The work weeks are set in accordance with the corresponding expected value controls. When the expected value control is set to zero, the program acts in an integer round off computation mode for the service channel requirements. In this mode, one is cautioned that excessively long work weeks can lead to queues which are not computed within this program, i.e., if indeed there were a work demand requiring work 168 hours per week and the work week were input as 168 hours per week, i.e., repair rate equals demand rate, then the queue would, in general, be long. When the expected value control for manpower is set to one, the work week should correspond to the manpower salary scale, i.e., if the salary scale is on the basis of a 40 hour week, then the work week should be input as 40 hours.

YD The length of the development phase of the program in years. It is only used in computing present value of costs incurred during a development phase (definition for FINT).

YMWO The number of MWOs per year per LRU.

YP The length of the production or acquisition phase in years. It is used in computing the present value of costs incurred during the production phase. It is also used in estimating the initial production rate which is used as a reference rate in the main program in the computation of reorder buy quantities.

YR The duration of the operation and maintenance portion of the program in years. Many of the cost computations for support are directly proportional to this input. It is also used in computing present value of operation and maintenance expenditures.

YZ Input in the dimension of years and may be positive or negative. It is used in the computation of present value of costs to change the zero point of reference at which present value is started. The program treats YD, YP, and YR as consecutive nonoverlapping time intervals. Nominally, present value is computed for the end of the production phase and the start of the operation and maintenance phase. YZ shifts this point by as many years ahead of or after it. Thus, if YZ equals the negative of YP, then present value is stated at the start of the production phase. If YZ is positive, it moves the point so many years into the O&M period from its start. Shifting YZ from LRU to LRU in the input sequence of LRUs being analyzed and using sunk cost input controls can accomplish, at present value, a time phasing of program cost totals.

ZFL[23] Round-off rule used in computing service channel quantities when integer round-off is invoked.

ZI Fraction of MWOs installed at General Support.

ZM An array of dimension three to specify the round-off fractions for modules at Direct, General, and Depot supply points (ZFL).

ZO Fraction of MWOs installed at Direct Support.

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23. The round-off rules ZFL, ZM, ZP, and ZU all act in the same manner. The values input are added to the demands computed by the program and then the fractional part is dropped and the whole number is retained. This is done to avoid acquisition of fractional portions of test equipment, LRUs, modules, and parts.

ZP An array of dimension three to specify the round-off fractions for parts at Direct, General, and Depot supply points (ZFL).

ZU An array of dimension four to specify round-off fractions for LRUs at equipment, Direct, General, and Depot supply points (ZFL).

Appendix C. USING LOCAM 5 (A SAMPLE PROBLEM)

The approach to explaining the use of LOCAM 5 is to set up a realistic sample problem and then to use the model to solve the problem in terms of life cycle logistics support costs and equipment availability. All of the steps involved in this typical application are shown to demonstrate how the model is used and the results obtained. Other applications of the LOCAM family of models are listed in the Bibliography.

1.0 Sample Problem Definition

The example problem addresses the prediction of logistic support costs for a hypothetical land combat missile system composed of several LRUs.

1.1 Operational Scenario

The operational scenario comprises two geographical deployments:

a) A European overseas deployment USAREUR.

b) A continental United States deployment CONUS.

Figure C-1 illustrates the repair flow associated with the USAREUR deployment. As depicted for this situation, the missile system in the field is maintained by direct exchange of failed LRUs from stock at the Integrated Direct Support Maintenance (IDSM) level. The study assumes nine IDSMs and three classes of LRUs are evaluated as follows:

a) Class 1 LRUs are repaired at the CONUS Depot.

b) Class 2 LRUs are repaired at overseas Direct Support sites by module replacement and overflow LRUs and modules are reparied at the CONUS Depot. Two DS sites are considered in the example analysis.

c) Class 3 LRUs are repaired at at an overseas General Support site by module replacement and overflow LRUs and modules are repaired at the CONUS Depot.

1.2 Example Problem Data Base

Typically, the data base for a logistics cost analysis application of the LOCAM 5 model involves several categories of information:

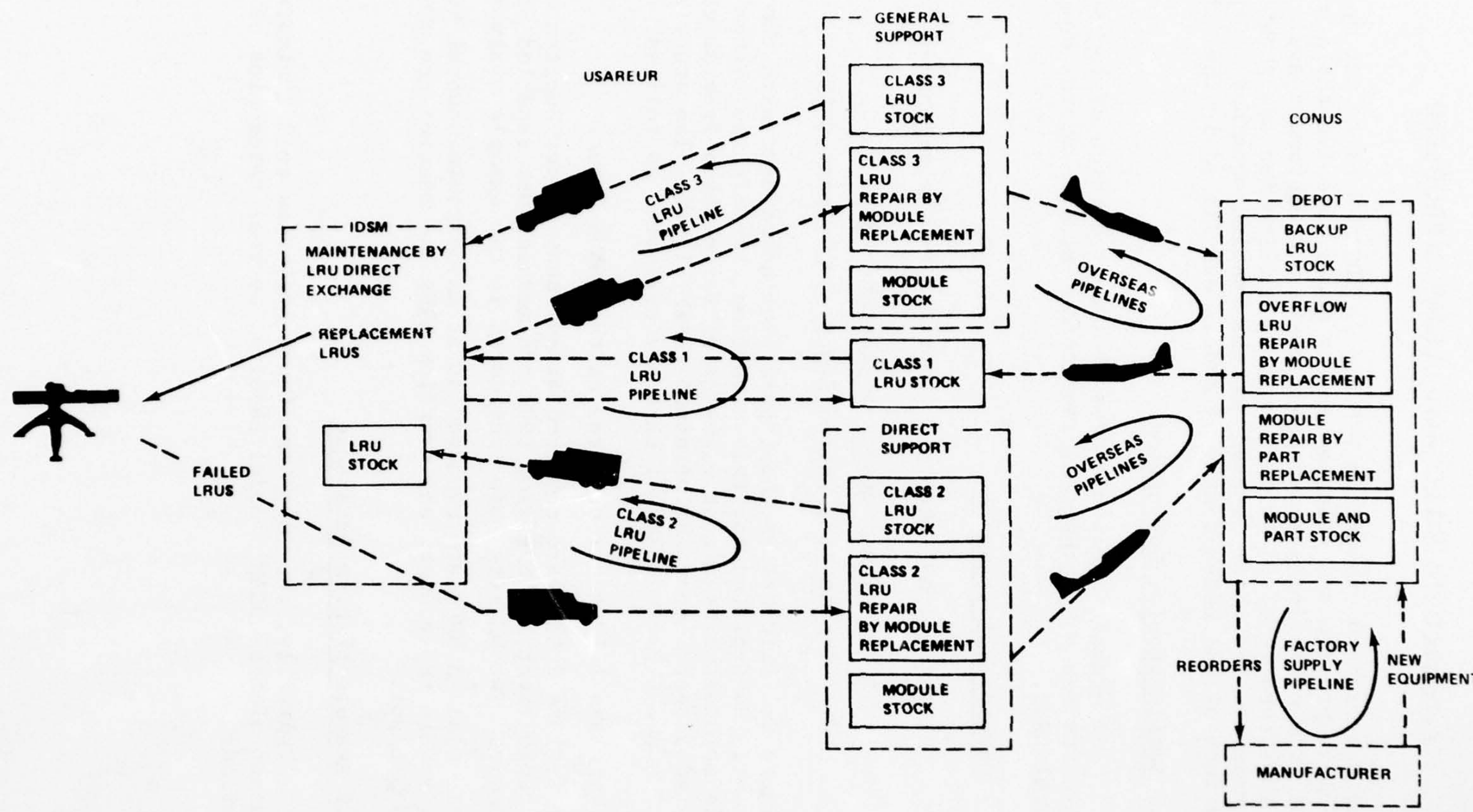

Figure C-1. Repair flow for USAREUR deployment of land combat missile systems.

a) Deployment Factors: Number of systems supported, geographical location, utilization rate, support hierarchy to include relation to organizational structure, and number of supply points.

b) Equipment Factors: Equipment breakdown, units, modules, parts; removal rates; physical characteristics; operating times; and costs per unit, module, and part.

c) Maintenance Factors: Turn around times, delay times, order and ship times, operating and safety stock levels.

d) Supply Factors: Stockage policies, supply times, production lead times, stockage costs, and transportation factors.

e) LRU Modifications: Modifications or ECNs of fielded LRUs and the provision quantity during the operational phase of the program.

f) Test Equipment Factors: Test equipment characteristics, costs, and support maintenance requirements.

1.2.1 Deployment Factors: The following deployment factors are involved.

a) The number of operational missile systems, ED*

USAREUR – ED = 141

CONUS – ED = 40 .

b) The fraction of real time that each missile system is operated, OTF = 0.0548. (This is equivalent to a total operating time of 480 hours per year).

c) Hierarchy and number of support and supply installations:

	USAREUR		CONUS	
EQUIP.	ED = 141	EDS = 141	ED = 40	EDS = 40
IDSM	OD = 9	ODS = 9	OD = 4	ODS = 4
DSU	DI = 2 (Class 1 and 2 LRUs)	DIS = 2	DI = 4	DIS = 4
GSU	DI = 1 (Class 3 LRUs)	DIS = 1		
Depot	DD = 1	DDS = 1	DD = 1	DDS = 1

*Symbols indicate LOCAM 5 input mnemonics (Appendix B).

As indicated by the preceding deployment factors, the LOCAM 5 model can be used to analyze several geographic scenarios and the results combined to determine worldwide support costs for military weapons systems. LOCAM 5 differs from the previous versions of the model in that it not only provides the capability to accumulate totals from one deployment to another and print out a grand total for two or more geographical scenarios but also provides the capability to sum the results for the individual LRUs and provide a printout for two or more geographical locations on an individual LRU basis. This is a accomplished by revisions between the LOCAM 4 and LOCAM 5 programs and by suitable use of the program controls. For example, a new header card is inserted as the eight card in the input deck on which the word "TOTAL" is punched along with a number designating the number of LRUs comprising the system under analysis (Appendix D). The LRUs must also be given in the same sequence for each theater of operation. In the revised program, the control NU = -3 provides a new function. In the example problem, the value NU = -3 is input with the final LRU of the CONUS deployment. This activates the printout of a CONUS totals page and LRU pages for all LRUs which are the sum of the CONUS + USAREUR LRU pages and finally a "GRAND TOTAL" printout which is the sum of all costs for USAREUR + CONUS for all LRUs.

The principal differences between the USAREUR and CONUS scenarios is the number of deployed missile systems, the support hierarchy, several of the pipeline factors, and the prorated share of the cost to enter and keep items in the inventory. For the CONUS scenario, a deployment of forty missile systems at four training installations is assumed. Each installation has the equivalent of an IDSM and a DSU maintenance plus supply point. These are backed up by a common CONUS depot for overflow LRU and module repair. Inputs related to test equipment development are not included in the CONUS input data set because they have already been charged against the USAREUR situation.

1.2.2 Equipment Factors. The LRUs are considered in the example problem breakdown module and part level. The maintenance policy is determined based on direct exchange of LRUs by the organizational IDSM. The IDSM maintains a direct exchange of LRUs with either a supporting DSU, GSU, of Depot depending on the LRU class and whether the scenario is USAREUR or CONUS. The maintenance policies used for the example problem are as follows:

	USAREUR	CONUS
Class 1 LRUs,	GT = 1	GT = 1
Class 2 LRUs,	GS = 0.85, GT = 0.15	GS = 0.85, GT = 0.15
Class 3 LRUs,	GS = 0.7, GT = 0.3	GT = 1

The costs for LRUs, breakdown of LRUs by module and part types, maintenance incident rates, and test and repair times are shown in Table C-1.

The weight and cube of LRUs, modules and parts are shown in Table C-2. Weights and cubes have been factored to include packaging material weights and storage space.

LRU descriptive quantities may also be recorded by filling out the multi-LRU worksheets discussed in Section 8. Tables C-3, C-4, C-5, and C-6 show these worksheets filled out with the sample problem LRU data.

1.2.3 Supply Factors

1.2.3.1 Maintenance Times (MIRADCOM Maintenance Rules). LOCAM 4 includes an additional way to compute initial provision quantities called "MICOM Maintenance Rules". This computation is activated by setting AYZP = 1 and the requirement to define several new input data factors*. The example problem includes the use of the MIRADCOM maintenance rules and uses the following values for the maintenance time input data factors:

Turn-around time at Equipment Level	TATE =	3 days
Turn-around time at Direct Support	TAT(1) =	15 days
Operating level for Direct, General	OL(1) = OL(2) =	15 days
Safety level for Direct, General	SL(1) = SL(2) =	15 days
Order and ship times for Direct, General	OST(1) = OST (2) =	15 days
Turn-around time at General	TAT(2) =	30 days
Turn-around time at Depot	TAT(3) =	127 days
Operating level at Depot	OL(3) =	30 days
Safety level at Depot	SL(3) =	30 days
Order and ship time Depot (USAREUR)	OST(3) =	30 days
Order and ship time Depot (CONUS)	OST(3) =	20 days
Evacutaion delay time between GS and Depot (USAREUR)	DTI =	60 days
Evacuation delay time between GS and Depot (CONUS)	DTI =	30 days
Evacuation delay time between DS and GS or Depot (USAREUR)	DTO =	60 days

*Op. Cit., Addendum of Changes to LOCAM 3 User's Manual for LOCAM 4 Users.

TABLE C-1. EQUIPMENT FACTORS

LRU	Unit Cost ($)	Module Cost ($)	Part Cost ($)	Number Module Types	Number Part Types	Maintenance Incident Rate (hour)	Unit Test Time (hour)	Unit Repair Time (hour)	Module Test Time (hour)	Module Repair Time (hour)
	CUP	CMP	CPP	P	PP	E	TI or TD	TIR or TDR	TMD	TMDR
Class 1-No. 1	988	500	3.0	3	20	0.0001	0.25	0.5	0.8	1.3
Class 1-No. 2	988	500	2.5	3	30	0.0001	0.25	0.5	0.6	1.1
Class 1-No. 3	988	500	7.0	2	20	0.0005	0.25	0.5	0.5	0.9
Class 1-No. 4	741	450	0	2	0	0.0005	0.25	0.5	0	0
Class 2-No. 1	57,730	2080	12.5	15	50	0.0021	2.0	2.0	0.5	0.9
Class 2-No. 2	17,613	1126	18.0	10	40	0.0017	1.8	1.5	0.5	0.9
Class 2-No. 3	18,827	1500	10.5	8	40	0.0011	0.5	1.5	0.4	0.8
Class 2-No. 4	12,250	1360	9.0	4	40	0.001	0.8	1.8	0.3	0.6
Class 2-No. 5	5,000	1000	6.0	4	40	0.0008	1.0	1.8	0.1	0.4
Class 3-No. 1	27,716	1610	6.0	12	50	0.001	0.5	1.6	0.3	0.6
Class 3-No. 2	75,262	2500	11.0	13	40	0.0013	1.0	3.5	0.75	3.4

TABLE C-2. WEIGHT AND CUBE FACTORS

LRU	Ship Weight (lb)			Storage Volume (ft^3)		
	LRU	Module	Part	LRU	Module	Part
	WU	WM	WP	CUBEU	CUBEM	CUBEP
Class 1 - No. 1	7.5	0.1	0.05	0.12	0.005	0.003
Class 1 - No. 2	4.5	0.2	0.1	0.15	0.015	0.005
Class 1 - No. 3	3.0	0.5	0.1	0.1	0.01	0.005
Class 1 - No. 4	3.0	0.5	0	0.1	0.01	0
Class 2 - No. 1	40.0	2.0	0.1	0.75	0.02	0.005
Class 2 - No. 2	26.0	1.5	0.08	0.7	0.02	0.005
Class 2 - No. 3	36.0	2.0	0.1	0.75	0.02	0.005
Class 2 - No. 4	40.0	2.0	0.1	0.75	0.02	0.005
Class 2 - No. 5	36.0	2.0	0.1	0.75	0.02	0.005
Class 3 - No. 1	30.0	1.5	0.08	1.0	0.05	0.01
Class 3 - No. 2	150.0	15.0	0.5	15.0	0.5	0.05

Evacuation delay time between DS and GS or Depot (CONUS)	DTO =	30 days
Shipping turn around time from field to Depot and return (USAREUR)	STAT =	60 days
Shipping turn around time from field to Depot and return (CONUS)	STAT =	20 days

1.2.3.2 Production Lead Times. Administrative and production lead times are those required for purchasing consumed spares. Factory start-up times include time from initiation of contract to delivery of first production run. The baseline example problem assumes the following values:

LRUs, FTU = 64 weeks (USAREUR), 56 weeks (CONUS).

Modules, FTM = 38 weeks (USAREUR), 30 weeks (CONUS).

Parts FTP = 20 weeks (USAREUR), 12 weeks (CONUS).

TABLE C-3. LRU DATA FORM NO. 1

System Sample Problem

Date 30 July 1976

LRU	CUP ($)	CMP ($)	CPP ($)	MTBF Operating (hours)	MTBMA KxMTBF	E $\frac{1}{MTBMA}$	P	PP	EE	Repeat	CEND ($)	CPE ($)	Maintenance Policy
Class 1 LRU No. 1	988	500	3.0	-	-	0.0001	3	20	1	1	-	-	
Class 1 LRU No. 2	988	500	2.5	-	-	0.0001	3	30	1	1	-	-	
Class 1 LRU No. 3	988	500	7.0	-	-	0.0005	2	20	1	1	-	-	
Class 1 LRU No. 4	741	450	0	-	-	0.0005	2	0	1	1	-	-	
Class 2 LRU No. 1	57,730	2080	12.5	-	-	0.0021	15	50	1	1	-	-	
Class 2 LRU No. 2	17,613	1126	18.0	-	-	0.0017	10	40	1	1	-	-	
Class 2 LRU No. 3	18,827	1500	10.5	-	-	0.0011	8	40	1	1	-	-	
Class 2 LRU No. 4	12,250	1360	9.0	-	-	0.001	4	40	1	1	-	-	
Class 2 LRU No. 5	5,000	1000	6.0	-	-	0.0008	4	40	1	1	-	-	
Class 3 LRU No. 1	27,716	1610	6.0	-	-	0.001	12	50	1	1	-	-	
Class 3 LRU No. 2	75,262	2500	11.0	-	-	0.0013	13	40	1	1	-	-	

TABLE C-4. LRU DATA FORM NO. 2

System Sample Problem

Date 30 July 1976

LRU	WU (lb)	WM (lb)	WP (lb)	CUBEC (ft^3)	CUBEM (ft^3)	CUBEP (ft^3)	TF (hour)	TFR (hour)	TMO (hour)	TMOR (hour)	TI (hour)	TIR (hour)	TMI (hour)	TMIR (hour)	FNSP
Class 1 LRU No. 1	7.5	0.1	0.05	0.12	0.005	0.003	-	-	-	-	0.25	0.5	-	-	
Class 1 LRU No. 2	4.5	0.2	0.1	0.15	0.015	0.005	-	-	-	-	0.25	0.5	-	-	
Class 1 LRU No. 3	3.0	0.5	0.1	0.1	0.01	0.005	-	-	-	-	0.25	0.5	-	-	
Class 1 LRU No. 4	3.0	0.5	0	0.1	0.01	0	-	-	-	-	0.25	0.5	-	-	
Class 2 LRU No. 1	40.0	2.0	0.1	0.75	0.02	0.005	-	-	-	-	2.0	2.0	-	-	
Class 2 LRU No. 2	26.0	1.5	0.08	0.7	0.02	0.005	-	-	-	-	1.8	1.5	-	-	
Class 2 LRU No. 3	36.0	2.0	0.1	0.75	0.02	0.005	-	-	-	-	0.5	1.5	-	-	
Class 2 LRU No. 4	40.0	2.0	0.1	0.75	0.02	0.005	-	-	-	-	0.8	1.8	-	-	
Class 2 LRU No. 5	36.0	2.0	0.1	0.75	0.02	0.005	-	-	-	-	1.0	1.8	-	-	
Class 3 LRU No. 1	30.0	1.5	0.08	1.0	0.05	0.01	-	-	-	-	0.5	1.6	-	-	
Class 3 LRU No. 2	150.0	15.0	0.5	15.0	0.5	0.05	-	-	-	-	1.0	3.5	-	-	

TABLE C-5. LRU DATA FORM NO. 3

System Sample Problem

Date 30 July 1976

LRU	TD (hour)	TDR (hour)	TMD (hour)	TMDR (hour)	TRC (hour)	TC (hour)	CLRUPG ($)	CMODPG ($)	CPUBII ($)	CKIT ($)	WTIKIT (lb)	ZI	ZO	OTF	SPE
Class 1 LRU No. 1	0.25	0.5	0.8	1.3	1	-	-	-	-	148	1	0	0		
Class 1 LRU No. 2	0.25	0.5	0.6	1.1	1	-	-	-	-	148	1	0	0		
Class 1 LRU No. 3	0.25	0.5	0.5	0.9	1	-	-	-	-	148	1	0	0		
Class 1 LRU No. 4	0.25	0.5	0	0	1	-	-	-	-	111	1	0	0		
Class 2 LRU No. 1	2.0	2.0	0.5	0.9	1	-	-	-	-	5773	10	0.5	0		
Class 2 LRU No. 2	1.8	1.5	0.5	0.9	1	-	-	-	-	1716	10	0.5	0		
Class 2 LRU No. 3	1.8	1.5	0.4	0.8	1	-	-	-	-	1883	10	0.5	0		
Class 2 LRU No. 4	0.8	1.8	0.3	0.6	1	-	-	-	-	500	10	0.5	0		
Class 2 LRU No. 5	1.0	1.8	0.1	0.4	1	-	-	-	-	500	10	0.5	0		
Class 3 LRU No. 1	0.5	1.6	0.3	0.6	1	-	-	-	-	2772	10	0.7	0		
Class 3 LRU No. 2	1.0	3.5	0.75	3.4	1	-	-	-	-	7526	30	0.7	0		

TABLE C-6. LRU DATA FORM NO. 4

System Sample Problem Date 30 July 1976

LRU	TMOD (hour)	TMID (hour)	TMDD (hour)	TOMW (hour)	TIMW (hour)	TDMW (hour)
Class 1 LRU No. 1	--	1	1	--	0.5	0.5
Class 1 LRU No. 2	--	1	1	--	0.5	0.5
Class 1 LRU No. 3	--	1	1	--	0.5	0.5
Class 1 LRU No. 4	--	1	1	--	0.5	0.5
Class 2 LRU No. 1	--	1	1	--	0.5	0.5
Class 2 LRU No. 2	--	1	1	--	0.5	0.5
Class 2 LRU No. 3	--	1	1	--	0.5	0.5
Class 2 LRU No. 4	--	1	1	--	0.5	0.5
Class 2 LRU No. 5	--	1	1	--	0.5	0.5
Class 3 LRU No. 1	--	1	1	--	0.5	0.5
Class 3 LRU No. 2	--	1	1	--	0.5	0.5

1.2.3.3 Transportation Factors. Shipping and handling costs to and from USAREUR and the CONUS depot by air and to the depot from the contractor by truck in CONUS were used. Air costs to and from USAREUR per round-trip were assumed to be:

CDID + CCDI = $0.66/lb/trip

and for the factory to depot trip:

CDFD = $0.63/lb/trip (USAREUR), $0.33/lb/trip (CONUS).

1.2.3.4 Supply Administration. The cost to enter a line item in stock, CEN = $1077 (USAREUR) and CEN = $451 (CONUS). The cost to retain an item in the supply system CAD = $436 (USAREUR) and CAD - $170 (CONUS). Recorder costs are as follows:

LRUs, CRU = $835 per action.

Modules, CRM = $835 per action.

Parts, CPR = $835 per action.

1.2.3.5 Minimum Order Quantities. The example problem uses the following input values:

LRUs QMU = 20

Modules QMM = 50

Parts QMP = 100

1.2.3.6 False No-Go Factors. The example problem uses a value of 20% for this factor:

FNGF = 0.2

1.2.4 LRU Modification Workload. The LOCAM 5 model also has the capability to accommodate the workload associated with modifications (MWOs) to the fielded and pipeline LRUs during the operational life cycle. In the example problem, several MWO factors were assumed to be the same for all LRUs.

The MWO rate per year, YMWO = 0.2.

The MWO field or depot test time, TIMW = TDMW = 0.5 hour.

The MWO field or depot repair time, TIMD = TMDD = 1 hour.

Other MWO factors varied with the type of LRU. These are shown in Table C-7.

1.2.5 Test Equipment Factors. LOCAM 5 uses an integer control JTED to designate the type and location of the test equipment. Four types of test equipment can be accommodated in the LOCAM 5 model:

a) Type I can be located in field or depot and is sometimes* used to represent automatic test equipment.

b) Type II can be depot located only and is sometimes* used to represent factory type manual test equipment.

c) Type III can be located in field or depot and is generally used to represent calibration equipment.

d) Type IV is generally used to represent contact support sets in the field.

The maintenance policies and the integer control JTED control the location of the first two types of test equipment as follows:

*Test equipment input factors are generic and development, acquisition, and documentation or software cost factors can be subject to varied interpretations.

TABLE C-7. INPUTS RELATED TO MODIFICATION WORKLOAD – MWO

LRU	MWO Performed in Field (%)	Cost of MWO Kit ($)	Shipping Weight of MWO Kit (lb)
	ZI	CKIT	WTKIT
Class 1 – No. 1	0	148	1
Class 1 – No. 2	0	148	1
Class 1 – No. 3	0	148	1
Class 1 – No. 4	0	111	1
Class 2 – No. 1	0.5	5773	10
Class 2 – No. 2	0.5	1716	10
Class 2 – No. 3	0.5	1883	10
Class 2 – No. 4	0.5	1225	10
Class 2 – No. 5	0.5	500	10
Class 3 – No. 1	0.7	2772	10
Class 3 – No. 2	0.7	7526	30

a) If the value of JTED is input as 1, then Type I can be located in the Depot.

b) If the value of JTED is input as 2, Type II can be located in Depot.

c) Type I test equipment can be field located regardless of the JTED value.

For the example problem, the following inputs pertaining to test equipment apply:

1.2.5.1 USAREUR/CONUS (JTED = 2). Type I test equipment represents the test equipment at the DS sites:

Test Equipment Development Cost, CI (charged only in USAREUR portion of run)	= $1,824,000
Test Equipment Acquisition Cost Per Set, CIP=	131,500
Annual Cost for Test Equipment Maintenance for Consumed Materials Per Set, CRI	= $ 6,000

Type II test equipment represents the test equipment at the depot:

Test Equipment Development Cost, CII (charged only in USAREUR portion of run)	= $1,370,000
Test Equipment Acquisition Cost, CPII	= $ 246,000
Annual Cost for Test Equipment Maintenance for Consumed Material, CRII	= $ 7,500

Type III test equipment represents the test equipment at the GS site:

Test Equipment Acquisition Costs, CCALP	= $ 220,000
Annual Cost for Test Equipment Maintenance for Consumed Material CCALR	= $ 2,000

Type IV test equipment represents the test equipment at the IDSM sites:

Test Equipment Development Cost, CCSP (charged only in USAREUR portion of run)	= $ 425,000
Test Equipment Acquisition Cost Per Set CCSPP	= $ 100,000
Annual Cost for Test Equipment Maintenance for Consumed Material Per Set, CCSPR	= $ 1,000

1.2.5.2 Test and Repair Manpower and Training. The expected value option was used to accumulate manpower costs on a prorated basis depending on cumulative workload for the example problem. In effect, this implies that manpower costs, adjusted for suitable productivity factors, are accrued for the cumulative test and repair man hours. If the workload is such that only a fractional part of the available man hours per year is used, then a fractional part of the annual salary of a test or repairman is charged.

The annual salaries used for maintenance manpower are as follows:

DS of GS Test and Repairmen,	CGMAN	= $16,600
	CGRMAN	= $16,600
Depot Test and Repairmen,	CDPMAN	= $26,100
	CDPRMN	= $26,100
Manpower Producitivity Factors,	TGMAN	= 2
	TGRMAN	= 2
	TDPMI	= 2
	TDPMII	= 2
	TDPRI	= 2
	TDPRII	= 2

The annual turnover factor for test equipment manpower, ARA = 0.4. The annual cost to train one man, CTRA = $2350.

2.0 Program Output for Sample Program

As programmed in LOCAM 4 and LOCAM 5, the OUTPUT and TOTALS printout instructions have been placed in-line to the main program rather than being separate subroutines as programmed for previous versions of LOCAM. Along with the printouts of study results NAMELISTS /L/ and /LL/ can be printed as before depending on the value input for the control IO. In addition, LOCAM 4 incorporated a new feature which is retained in LOCAM 5 wherein a formatted listing of the entire sequence of input data for all LRUs up to and including the present LRU will be printed out in columnar fashion. Inputting the value IO = 3 activates this new section of the model and this feature greatly facilities the examination of an entire sequence of input values.

2.1 Input Deck Structure

A listing of the input data deck used for the example problem is shown in Appendix D. This problem parallels the Field Support case included as one of the two cases used as the sample problem solved for the LOCAM 3 users manual* except for factors which are input to test the new features added to formulate the LOCAM 5 version of the model. The general structure of the input deck is as follows:

2.1.1 Nonrecurring Inputs at Program Initialization

TEXT - TEXT is input from four punched cards punched in Columns 1 through 72. Subroutine PAGE prints TEXT as four lines of page header information.

ANLYIS - ANLYIS is input from a single card punched in Columns 1 through 18. Subroutine PAGE prints ANLYIS immediately to the right of the formatted statement:

ANALYSIS -

DATE - DATE is input from a single card punched in Columns 1 through 18. Subroutine PAGE prints DATE immediately to the right of the formatted statement:

DATE -

COSTIS - COSTIS states the problem scale factor in words that are
AMULT printed out on every output page. AMULT gives the numerical value of the scale factor as a real number. It is

*Op. Cit., Users Manual for MICOM Program LOCAM 3.

used to convert all output cost data from dollars to some other convenient unit of output. It is used as a multiplier. Thus, for example, if AMULT is 0.001, COSTIS would be entered as THOUSANDS OF DOLLARS. COSTIS and AMULT are entered together on a single punched card. COSTIS is punched in Columns 1 through 36. AMULT is punched in Columns 42 through 51.

TOTAL - TOTAL is new to LOCAM 5. It is a nonrecurring input card which indicates that a summation of each LRU for all theaters is called. Individual LRUs in the input data for each case (theater) must be identically sequenced for the LRU summation to be meaningful. The number of distinct LRUs for which a total is to be taken over all cases in a concept must also be punched on the TOTALS card.

2.1.2 Recurring Inputs Which Must be Entered at Each Item (LRU) Input Cycle

UNITIS - UNITIS describes the current item (LRU) being entered. It is entered from a single card punched in Columns 1 through 18. Subroutine page prints UNITIS to the right of the formatted statement:

UNIT -

REMARK - REMARK is used in connection with UNITIS to record any qualifying information for the current item (LRU) under analysis. The qualifying information might include System No., Case No., theater, or other titles pertaining to a group of LRUs. REMARK is entered from a single card punched in Columns 1 through 72. Subroutine PAGE prints REMARK immediately below the prints of UNITIS.

2.1.3 Recurring Inputs Which are Entered Using NAMELIST/L/. All program inputs (Appendix B), except AMULT, are entered using NAMELIST/L/. It is the property of NAMELIST that any one or more of the variables appearing in the NAMELIST may be entered at the read of NAMELIST. At least one must be entered. Thus, at each input cycle for each new item (LRU), only the inputs which must be changed from the previous item need be entered. There are three considerations related to the deck structure for a case or system of LRUs:

a) The LOCAM 5 model provides default values for inputs not entered. Thus, the analyst may start with little precise data and become more exact as the data base builds up. In the program, a BLOCK DATA subroutine initializes all inputs prior to the read of NAMELIST.

b) For a particular system of LRUs, there is generally a class of data which is common to all LRUs; these data need only be entered once with the first LRU of the system.

c) Finally there are the LRU data such as those shown in Tables C-1, C-2, and C-7 which must be entered with each LRU provided that the value of the input changes between successive LRUs.

2.1.4 The Sample Problem Input Listing. Examination of the input listing shown in Appendix D indicates that the rules and sequence for structuring the input deck discussed in the three previous sections have been followed in setting up the sample problem input deck. First the header describing the analysis is shown as four lines of text. The next four cards designate the type of analysis, the date, the scale factor multiplier, and that LRU totals for both theaters are to be taken respectively. This is followed by the first LRU title card and the card which gives the case number, theater, and a summary of the LRU maintenance concepts.

Now the data for the first LRU in the NAMELIST format are given. This format requires that NAMELIST start with the characters &L and end with &END. This is characteristic of UNIVAC SPECTRA and IBM 360 computers. It is noted that the first LRU of the set contains many more punched cards than any of the subsequent LRUs since, as noted previously, the first LRU of a set contains all of the input data that are common to all or most of the LRUs which follow and these common data need only be input one time. Data inputs continue for each LRU of the first theater (USAREUR); the last LRU is Class 3 LRU No. 2. Then the data for CONUS follow and so on until the input data for all eleven LRUs in the system are entered.

This is followed by a set of punched cards for sensitivity testing to determine the effect of variation of failure rate. As discussed in Section 7, the sensitivity cards are punched as an input Array called SENSY in the NAMELIST format. The first element in the array called MODE designates the number of inputs being varied simultaneously. Thus, if MODE is one, only one input is being varied. The second element of SENSY called NPASS denotes the number of sets of variations being run. NPASS is the number of times that unit ND in the program (listing in Appendix F) will be rewound and reread. Thus for example, if two values of failure rate (E) are to be run, the NPASS is two and the second element of SENSY in input as "2.,".

The remaining elements of SENSY are assigned in groups according to MODE. Each group is an ordered sequence of data and there are MODE entries in each group. The first group is a statement of the RULE to be used for assigning a value to each of the MODE variables for a particular SENSY run set. There are five RULES and the RULE number is a whole number from 1 to 5 inclusive. These RULES are stored in array "NRULE."

The RULES are as follows:

a) To assign the value from SENSY to the input.

b) To add the value from SENSY to the input variable.

c) To subtract the value from SENSY from the input variable.

d) To multiply the input variable by the value from SENSY.

e) To divide the input variable by the value from SENSY.

The second group of entries, also of length MODE, is an ordered sequence designating the sequence numbers of the inputs included in the particular SENSY run set.

In the designation of the inputs for sensitivity testing, the program is structured to reference them by their numbered positional location in common block INPUT rather than by name. The numbered sequence for addressing LOCAM 5 inputs to be sensitivity tested is given in Table C-8. The listing shown is alphabetically and numerically sequenced.

The third group is the first set of values to be applied to the input variables. These values are assigned according to the set of "RULES" defined previously. There will be "NPASS" sets of values. For example, the code designation Table C-8 for FNGF is 96, then the input Δ & LΔSENSY = 1., 2., 1., 96., 0., .2Δ&END signifies that two passes of the variable FNGF will be run. On the first pass the value assigned will be zero and on the second pass the value 0.2 will be assigned.

Assignment is made in the main program where the values in core memory are altered after the data on unit ND are read into core memory. After the last pass, all elements of SENSY are set to zero. The baseline data set still resides on unit ND and at the next read of NAMELIST/L/, a new SENSY array can be input.

2.1.5 The Basic Data Deck. Referring back to the basic data deck shown in Appendix D, the USAREUR and CONUS input data decks are placed in series and the order of LRUs is identical for both theaters. This permits the use of the control NU = -3 to be tested to produce LRU printouts which are the sums of the previous LRU printouts for identical LRUs. The control NU = -3 also produces a GRAND TOTAL printout (the sum of all support costs for USAREUR plus all support costs for CONUS). Examination of the final LRU in the CONUS data set (Appendix D) shows the use of a card punched with the override value of NU = -3.

Although the data deck for the sample problem (Appendix D) is a new problem, it is very similar to the problem already solved*. As with the

*Op Cit., Addendum of Changes to LOCAM 3 User's Manual for LOCAM 4 Users.

TABLE C-8. ALPHABETICAL LISTING OF INPUTS ADDRESSABLE BY SENSY (GIVING FORTRAN NAME OF INPUT AND CORRESPONDING SENSY DESIGNATION NUMBER)

ARA	1	CONTCT	46	FINT	91	SMF	136	TOE	181	TAT(3)	226
AYZP	2	CPE	47	FMD	92	SMI	137	TOI	182	TAYZ(1)	227
CAD	3	CPI	48	FMI	93	SMO	138	TOMW	183	TAYZ(2)	228
CALMAN	4	CPII	49	FMO	94	SPE	139	TONMAN	184	TAYZ(3)	229
CALPUB	5	CPP	50	FN	95	SPEV	140	TRC	185	TAYZ(4)	230
CALSET	6	CPUBII	51	FNGF	96	SPEVR	141	TUMD	186	TAYZ(5)	231
CCAL	7	CRI	52	FNSP	97	SUD	142	TUMI	187	TAYZ(6)	232
CCALP	8	CRII	53	FSA	98	SUI	143	TUMO	188	TAYZ(7)	233
CCALR	9	CRM	54	FTI	99	SUO	144	WD	189	TAYZ(8)	234
CCSP	10	CRP	55	FTII	100	SVE	145	WDM	190	TAYZ(9)	235
CCSPP	11	CRU	56	FTM	101	SVR	146	WDR	191	TAYZ(10)	236
CCSPR	12	CSDEP	57	FTP	102	SVT	147	WI	192	ZM(1)	237
CDDI	13	CSDSU	58	FTU	103	SVV	148	WIM	193	ZM(2)	238
CDEO	14	CSGSU	59	FUD	104	TALMAN	149	WIR	194	ZM(3)	239
CDFD	15	CTCPUB	60	FUI	105	TATE	150	WM	195	ZP(1)	240
CDID	16	CTRA	61	FUO	106	TC	151	WO	196	ZP(2)	241
CDIO	17	CTRCAL	62	HPM	107	TD	152	WOM	197	ZP(3)	242
CDMAN	18	CTRI	63	HPP	108	TDI	153	WOR	198	ZU(1)	243
CDOE	19	CTRII	64	HPU	109	TDMAN	154	WP	199	ZU(2)	244
CDOI	20	CTRSPT	65	OD	110	TDMW	155	WTKIT	200	ZU(3)	245
CDPMAN	21	CUBEM	66	ODS	111	TDPMI	156	WU	201	ZU(4)	246
CDPRMN	22	CUBEP	67	OTF	112	TDMPII	157	YAT	202	STAT	247
CDRMAN	23	CUBEU	68	P	113	TDPRI	158	YD	203	DTO	248
CEN	24	CUCE	69	PMR	114	TDPRII	159	YMWO	204	DTI	249
CEND	25	CUP	70	PP	115	TDR	160	YP	205		
CFTD	26	DAOQL	71	PPR	116	TDRMAN	161	YR	206		
CGMAN	27	DD	72	PUR	117	TEO	162	YZ	207		
CGRMAN	28	DDS	73	QMM	118	TF	163	ZFL	208		
CI	29	DI	74	QMP	119	TFR	164	ZI	209		
CII	30	DIS	75	QMU	120	TGMAN	165	ZO	210		
CKIT	31	E	76	QTD	121	TGRMAN	166	H(1)	211		
CKMD	32	ED	77	QTE	122	TI	167	H(2)	212		
CKMI	33	EDS	78	QTI	123	TID	168	H(3)	213		
CKMO	34	EE	79	QTMD	124	TIMW	169	H(4)	214		
CKPD	35	EVDM	80	QTMI	125	TIO	170	OL(1)	215		
CKPI	36	EVDR	81	QTMO	126	TIR	171	OL(2)	216		
CKPO	37	EVDT	82	QTO	127	TMD	172	OL(3)	217		
CKUD	38	EVIM	83	QTPD	128	TMDD	173	OST(1)	218		
CKUE	39	EVIR	84	QTPI	129	TMDR	174	OST(2)	219		
CKUI	40	EVIT	85	QTPO	130	TMI	175	OST(3)	220		
CKUO	41	EVOM	86	RDD	131	TMID	176	SL(1)	221		
CLRUPG	42	EVOR	87	REPEAT	132	TMIR	177	SL(2)	222		
CMODPG	43	EVOT	88	RID	133	TMO	178	SL(3)	223		
CMP	44	FI	89	ROI	134	TMOD	179	TAT(1)	224		
CONMAN	45	FII	90	SMD	135	TMOR	180	TAT(2)	225		

previous problem, it tests the use of MIRADCOM maintenance rules and the associated pipelines. The use of AYZP = 1 with the initial LRU selects the MIRADCOM maintenance rule option and requires that inputs be provided for the pipeline factors, TATE, TAT, OL, SL, and OST, if applicable. Additionally three new input data factors are incorporated in LOCAM 5. These are STAT, DTI, and DTO; suitable values are included in the input data to test the use of these new data factors.

2.2 LRU Outputs

Figures C-2 and C-3 show the computer printouts for two individual LRU output pages obtained for the example problem. The results shown are for the final LRU (Class 3 LRU No. 2) of each scenario. Figure C-2 is for the USAREUR scenario. Figure C-3 shows the results obtained for the same LRU for the CONUS scenario. Output pages in this format can be obtained for each LRU in the data set depending on the value input for the control INHIB. The value INHIB = 1, when included with the LRU data deck, inhibits the printout of the LRU output page whereas INHIB = 0 allows printout of the LRU outputs as shown in Figures C-2 and C-3. As is usually the case for the final LRUs in the data set, the tally flags ETI, ETII, EACSP, AND EACAL may be set equal to unity if associated manpower and test equipment costs are applicable to the case being run. This causes tallies to be taken for accrued manpower workload for the different service channels. In addition, all pertinent manpower and test equipment costs are tallied with the other LRU output totals to be included in the cumulative cost totals. For the examples shown, the cumulative totals are the case cost totals because the final LRU in each data set is used as the illustration. Other exerpts from the sample problem run are shown in Appendix E.

2.3 Case and Grand Totals

Case cost total printouts for the USAREUR and CONUS scenarios are shown in Figures C-4 and C-5, respectively. The format for these presentations is the same as for the previous LOCAM 4 version of the program.*

It is noted that the sample runs are based entirely on expected value (shared) manpower. If the run had been based on dedicated manpower in the field, the difference (DELTA) between dedicated and shared manpower costs would have been printed out near the bottom of the case totals pages.

Model availabilities (CAYZ and CAYZI) are also printed out near the bottom of the page. In this instance, four sets of values are shown. The first set is the availability product for all eleven LRUs in the

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*Ibid.

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                    COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                    USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                    MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                    ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 3 LRU NO. 2                                                  ANALYSIS - THREE LRU CLASSES
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS     DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL
EACH      CUM
   14552.    39441.    THOUSANDS OF DOLLARS              AVAILABILITY=  .999915  INHERENT=  .999915
PRIME     T.E.     TE SPACE MANPOWER  SUPPLY     ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
    0.     3489.          0.     461.   10360.        3.        3.      185.       51.   14552.

PROVISION          INITIAL BUY          REORDER BUY          CONSUMED            RESIDUAL
UNIT  MODULE  PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART
  89.     6.    2.  230.  236.  238.   20.    50.  180.    0.    0.   20.   89.     6.    0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA
            DIRECT                                      GENERAL                                DEPOT
   T.E.                          REPAIR     T.E.                          REPAIR    T.E.                          REPAIR
   EACH       CUM      EACH        CUM      EACH      CUM      EACH         CUM     EACH       CUM      EACH        CUM
 0.0000    0.0000    0.0000     0.0000     .0121    .0186     .0332       .0469    .0130     .0883     .0494      .1583
           0.0000               0.0000              .0621                 .0991              .0883                .1583

ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
        DIRECT                            GENERAL                             DEPOT
T.E.      TE MEN     REP MEN    T.E.       TE MEN     REP MEN    T.E.       TE MEN    REP MEN
  0.         0.         0.        1.          0.         0.        0.          0.        0.
0.0000                          .0209                           0.0000
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
          DEPOT
T.E.      TE MEN     REP MEN
     1.        0.          1.
  .0972

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
   14552.    39441.     MANPOWER      461.     DELTA        0.     PV DELTA       0.
INITIAL PROVISION QUANTITIES OF
                        UNITS                                           MODULES                                   PARTS
   EQPT.     DIRECT     GENERAL      DEPOT        DIRECT    GENERAL      DEPOT        DIRECT     GENERAL      DEPOT
     0.        63.        12.         14.           0.         1.          0.            0.          0.          2.
   COST OF INITIAL PROVISION                                             RESIDUAL
          EQPT.       DIRECT      GENERAL      DEPOT       TOTAL
UNIT         0.        4742.        903.       1094.       6698.         6698.
MODULE                    0.         33.        163.        195.          195.
PART                      0.          0.          0.          0.            0.
```

Figure C-2. LOCAM 5 output format showing example problem results obtained for final USAREUR scenario LRU.

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                   COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                    USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                     MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                        ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.
UNIT - CLASS 3 LRU NO. 2                                                           ANALYSIS - THREE LRU CLASSES
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS                       DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL
EACH      CUM
    5186.     12490.     THOUSANDS OF DOLLARS               AVAILABILITY= .999915  INHERENT= .999915
PRIME     T.E.       TE SPACE MANPOWER  SUPPLY     ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
     0.     896.          0.        204.     3970.         1.        2.        73.       32.      5186.

PROVISION       INITIAL BUY          REORDER BUY           CONSUMED            RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART
  37.     1.    1.   77.    76.    79.   20.   50.  100.    0.     0.    9.   37.     1.    0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA
                DIRECT                                              GENERAL                                        DEPOT
     T.E.                              REPAIR     T.E.                                  REPAIR     T.E.                                 REPAIR
     EACH       CUM        EACH         CUM       EACH       CUM        EACH         CUM       EACH       CUM        EACH        CUM
   0.0000     0.0000     0.0000      0.0000     0.0000    0.0000     0.0000      0.0000     .0075     .0309      .0289      .0589
              0.0000                 0.0000               .0061                  .0074                .0309                 .0589

ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
         DIRECT                                    GENERAL                                    DEPOT
T.E.       TE MEN      REP MEN    T.E.       TE MEN      REP MEN    T.E.       TE MEN      REP MEN
    0.         0.          0.         0.         0.          0.         0.         0.          0.
0.0000                            0.0000                            0.0000
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
         DEPOT
T.E.       TE MEN      REP MEN
    1.         0.          0.
  .0340

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
    5186.     12490.     MANPOWER      200.     DELTA           0.    PV DELTA        0.
INITIAL PROVISION QUANTITIES OF
                      UNITS                                               MODULES                                            PARTS
  EQPT.      DIRECT     GENERAL       DEPOT          DIRECT    GENERAL      DEPOT          DIRECT     GENERAL        DEPOT
    0.         16.          0.         13.              0.         0.        11              0.          0.            1.
  COST OF INITIAL PROVISION                                                   RESIDUAL
        EQPT.        DIRECT       GENERAL        DEPOT        TOTAL
UNIT        0.        1204.          602.         970.        2700.          2700.
MODULE                   0.            0.          18.          80.            80.
PART                     0.            0.           0.           0.             0.
```

Figure C-3. Results obtained for final CONUS scenario LRU.

BEST AVAILABLE COPY

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        COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
         USING LIFE CYCLE COST OF OWNERSHIP AND OPERATICNAL AVAILABILITY AS THE
          MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
             ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.
ANALYSIS - THREE LRU CLASSES                                                     DATE - JANUARY 2,1977
                                                      CASE TOTAL
COST TOTALS, COST IN THOUSANDS OF DOLLARS                                       RECURRING COSTS
     INSTALLED EQUIPMENT                     0.
     TEST EQUIPMENT                       5708.                         T.E. MAINTENANCE         342.
     TEST EQUIPMENT SPACE                    0.                     DEPOT SPACE/UTILITIES          0.
     MAINTENANCE MANPOWER                  743.           FIELD    358.  DEPOT     344. TOTAL    702.
                                                  TRAINING FIELD    21.  DEPOT      20. TOTAL     41.
     SUPPLY MATERIAL                     31376.                                   SUPPLIES     10268.
     REORDERING                             25.                                 REORDERING        25.
     MATERIAL STORAGE                        4.                           MATERIAL STORAGE         4.
     SUPPLY ADMINISTRATION                1479.                       INVENTORY MANAGEMENT      1186.
     SHIPPING AND HANDLING                 107.                                   SHIPPING       107.

     GRAND TOTAL COST                    39441.                            TOTAL RECURRING     12674.


     PRESENT VALUE                                                   COST OF INITIAL PROVISION
     DEVELOPMENT                          3619.                                      UNITS     20097.
     ACQUISITION                         23149.                                    MODULES      1009.
     OPERATION AND MAINTENANCE           12674.                                      PARTS         3.
     END LIFE SALVAGE                        0.                            TOTAL PROVISION     21109.

     GRAND TOTAL                         39441.

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

     MAINTENANCE MANPOWER                  743.
     GRAND TOTAL COST                    39441.
     PRESENT VALUE
     OPERATION AND MAINTENANCE           12674.
     GRAND TOTAL                         39441.        DELTA        0.           PV DELTA        0.
  CAYZ=  .999329  .999921  .999560  .999849
 CAYZI=  .999330  .999921  .999560  .999849
                           MAN-E        DIRECT         GENERAL        DEPOT
HOURS PER DAY
   TEST EQUIPMENT          2.270        0.000          1.638          2.332
   REPAIR                  0.000        0.000          2.378          3.799
NUMBER OF MEN
   TEST EQUIPMENT          0.000        0.000           .573           .816
   REPAIR                  0.000        0.000           .832          1.338
```

Figure C-4. LOCAM 5 printout format for case cost totals page showing results obtained for USAREUR scenario.

data set; the second is the availability product for the first four LRUs (Class 1 LRUs); the third if the product for all Class 2 LRUs; and the fourth is the product of the availabilities for the two Class 3 LRUs.*

Finally, printouts are included at the bottom of the page showing the hours per day of test equipment and repair service channel utilization and the number of men required for service channel operation at the various maintenance echelons.

The format for the printout of GRAND TOTALS is shown in Figure C-6. This printout gives the sum of all significant cost elements for the USAREUR plus CONUS scenarios.

2.4 Individual LRU Summary Totals

As discussed in Sections 8.3 and 9.1, LOCAM 5 provides the versatility to sum up and print out the life cycle costs for two or more theaters of operation on an individual LRU basis. Figure C-7, the printout obtained for Class 3 LRU No. 2, shows the summation of the costs for the USAREUR plus CONUS scenarios. Actually, Figure C-7 is the composite of the results shown previously in Figures C-2 and C-3.

2.5 Sensitivity Listing Results

Included near the end of the input deck listing (Appendix D) is the sensitivity NAMELIST input data set which was run with the baseline USAREUR and CONUS data sets. The structure of this data set is as discussed in Section 7 and as prepared for the SPECTRA 70 series computer. It consists of four cards. Two are leader cards, indicating that failure rate (Maintenance Incident Rate) is to be varied. The third card indicates the number of inputs to be varied, the number of passes, the rule to be used, the designation of the input variable and the changes to the baseline values to be investigated. The final card shows that INHIB and IFLAG are activated. These are input as unity to suppress the printouts of individual LRU pages and the summary totals LRU printouts. The results thus obtained are in the case totals and grand totals formats previously discussed (Figures C-4, C-5, and C-6). The case totals printouts are always preceded by a listing of the new values of the inputs identified by the designation number given in Table 7. Thus, the new value of the input/inputs assigned by activating the sensitivity test feature of LOCAM 5 is always documented.

---

*Note: The values input for the array TAYZ control this printout. For the sample problem (Appendix D):

TAYZ = 2*1., 8*0., is input with the first LRU (Class 1 LRU No. 1).

TAYZ = 1., 0., 1., 7*0., in input with the fifth LRU (Class 2 LRU No. 1).

TAYZ = 1., 2*0., 7*1., is input with the tenth LRU (Class 3 LRU No. 1).

```
          COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
           USING LIFE CYCLE COST OF OWNERSHIP AND OPERATICNAL AVAILABILITY AS THE
            MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
              ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

ANALYSIS - THREE LRU CLASSES                                                            DATE - JANUARY 2,1977
                                                CASE TOTAL
COST TOTALS, COST IN THOUSANDS OF DOLLARS                                          RECURRING COSTS
     INSTALLED EQUIPMENT
     TEST EQUIPMENT                 [illegible]                                 T.E. MAINTENANCE       375.
     TEST EQUIPMENT SPACE                 0.                               DEPOT SPACE/UTILITIES         0.
     MAINTENANCE MANPOWER               284.             FIELD       75.  DEPOT        197. TOTAL      272.
                                                TRAINING FIELD        4.  DEPOT          7. TOTAL       12.
     SUPPLY MATERIAL                   9859.                                             SUPPLIES     3067.
     REORDERING                           6.                                           REORDERING        6.
     MATERIAL STORAGE                     2.                                     MATERIAL STORAGE        3.
     SUPPLY ADMINISTRATION              585.                                INVENTORY MANAGEMENT       462.
     SHIPPING AND HANCLING               49.                                             SHIPPING       49.

     GRAND TOTAL CCST                 1245C.                                      TOTAL RECURRING     4246.


     PRESENT VALUE                                                          COST OF INITIAL PROVISION
     DEVELOPMENT                          0.                                                UNITS     6476.
     ACCUISITION                       8204.                                              MODULES      314.
     OPERATION ANC MAINTENANCE         4246.                                                PARTS        2.
     END LIFE SALVAGE                     0.                                      TOTAL PRCVISION     6792.

     GRAND TOTAL                      12450.


EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

     MAINTENANCE MANPOWER               284.
     GRAND TOTAL CCST                 12450.
     PRESENT VALUE
     OPERATION AND MAINTENANCE         4246.
     GRANC TOTAL                      12458.         CELTA         0.          PV CFLTA        0.
 CAYZ=  .999321  .999912  .999560  .999849
CAYZI=  .999330  .999921  .999560  .999849
                          MAN-E        DIRECT        GENFRAL        DEPOT
HOURS PER DAY
   TEST EQUIPMENT          .644         0.000          .646          .815
   REPAIR                 0.000         0.000          .707         1.413
NUMBER OF MEN
   TEST EQUIPMENT         0.000         0.000          .226          .285
   REPAIR                 0.000         0.000          .248          .495
```

Figure C-5. LOCAM 5 printout format for case cost totals page showing results obtained for CONUS scenario.

```
              COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
               USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                   ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

ANALYSIS - THREE LRU CLASSES                                                          DATE - JANUARY 2,1977
                                             GRAND TOTAL
COST TOTALS, COST IN THOUSANDS OF DOLLARS                                           RECURRING COSTS
     INSTALLED EQUIPMENT              0.
     TEST EQUIPMENT                7373.                                    T.E. MAINTENANCE        717.
     TEST EQUIPMENT SPACE             0.                                DEPOT SPACE/UTILITIES         0.
     MAINTENANCE MANPOWER          1027.          FIELD      433.  DEPOT        541. TOTAL        974.
                                         TRAINING FIELD       26.  DEPOT         28. TOTAL         53.
     SUPPLY MATERIAL              41235.                                            SUPPLIES      13335.
     REORDERING                      31.                                          REORDERING         31.
     MATERIAL STORAGE                 6.                                    MATERIAL STORAGE          6.
     SUPPLY ADMINISTRATION         2064.                                INVENTORY MANAGEMENT       1648.
     SHIPPING AND HANDLING          155.                                            SHIPPING        155.

     GRAND TOTAL COST             51892.                                     TOTAL RECURRING      16920.

     PRESENT VALUE                                                      COST OF INITIAL PROVISION
     DEVELOPMENT                   3619.                                               UNITS      26573.
     ACQUISITION                  31353.                                             MODULES       1323.
     OPERATION AND MAINTENANCE    16920.                                               PARTS          5.
     END LIFE SALVAGE                 0.                                     TOTAL PROVISION      27900.

     GRAND TOTAL                  51892.

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

     MAINTENANCE MANPOWER          1027.
     GRAND TOTAL COST             51892.
     PRESENT VALUE
     OPERATION AND MAINTENANCE    16920.
     GRAND TOTAL                  51892.        DELTA          0.          PV DELTA          0.
```

Figure C-6. LOCAM 5 printout format for grand totals page showing summation of USAREUR plus CONUS case totals.

```
                                   COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                                   USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                                   MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                                   ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.
UNIT - CLASS 3 LRU NO. 2                                                              ANALYSIS - THREE LRU CLASSES
   TOTAL                                                                                DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL
EACH       CUM
    19738.     51892.      THOUSANDS OF DOLLARS
PRIME      T.E.        TE SPACE MANPOWER  SUPPLY      ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
        0.      4385.          0.         665.    14330.          4.          5.       250.        83.     19738.

PROVISION         INITAL BUY                                 CONSUMED          RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART                      UNIT  MODULE PART UNIT  MODULE PART
  126.    7.     3.  307.  314.  317.                      0.     0.    25.  126.    7.     0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA
                  DIRECT                                         GENERAL                                    DEPOT
     T.E.                              REPAIR      T.E.                             REPAIR      T.E.                               REPAIR
     EACH         CUM        EACH        CUM       EACH        CUM       EACH         CUM       EACH        CUM        EACH          CUM
   0.0000      0.0000      0.0000     0.0000      .0121      .0186      .0332       .0469      .0204      .1192      .0733        .2172
               0.0000                 0.0000                 .0682                  .1064                 .1192                   .2172

ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
            DIRECT                             GENERAL                                  DEPOT
T.E.        TE MEN      REP MEN   T.E.        TE MEN      REP MEN   T.E.        TE MEN      REP MEN
   0.          0.          0.        1.          0.          0.        0.          0.          0.
0.0000                            .0205                             0.0000
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
            DEPOT
T.E.        TE MEN      REP MEN
     2.          1.          1.
   .1311

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH       CUM
    19738.     51892.     MANPOWER        665.      DELTA            0.     PV DELTA         0.
INITIAL PROVISION QUANTITIES OF
                      UNITS                                                   MODULES                                        PARTS
   EQPT.        DIRECT     GENERAL        DEPOT            DIRECT      GENERAL      DEPOT          DIRECT      GENERAL       DEPOT
      0.           79.         28.          27.                0.          1.          6.              0.          0.          3.
COST OF INITIAL PROVISION                                                      RESIDUAL
          EQPT.        DIRECT        GENERAL        DEPOT          TOTAL
UNIT         0.          5946.          1505.        2032.          9483.         9483.
MODULE                      0.            33.         190.           228.          228.
PART                        0.             0.           1.             1.            0.
```

Figure C-7. LOCAM 5 printout format for individual LRU summary totals page showing summation of USAREUR plus CONUS costs for Class 3 LRU No. 2.

2.5.1 The Influence of Workload on Support Costs. The results obtained for the sensitivity runs made for the sample problem were used to construct the plots shown in Figures C-8 and C-9. Figure C-8 shows the effect of varying maintenance incident rate for the CONUS scenario, the USAREUR scenario, and the summation of the two deployments. Ten-year support costs are plotted as functions of maintenance incident rate multiple where the latter factor is a multiplier on the input data element E. The baseline value of unity reflects the support costs obtained for the basic values of E given in Table C-1. A maintenance incident rate multiple of two produces support costs associated with double the basic values of the input data element E.

Another way of viewing the same result is to plot support costs versus the inverse of maintenance incident rate. This was done to obtain the results shown in Figure C-9 which plots support costs versus MTBMA. Here, the curves display the characteristic "knee" as the time between maintenance actions increases.

2.5.2 The Versatility Provided by the Built-in Sensitivity Test Feature. The examples shown in the previous section and in Section 9.2.3 indicate the versatility of LOCAM 5. The sensitivity test feature of LOCAM 5 represents a powerful tool for the evaluation of logistic support alternatives. Practically any input variable or combination of variables can be varied through any range of values during any computer run. The use of the technique makes it possible to evaluate multiple effects on logistics cost and effectiveness very rapidly through the application of a carefully planned run set.

2.6 Sequenced Listing of Input Data

A feature of LOCAM 5 which greatly facilitates examination of inputs is the printout of a sequenced listing of all input data factors. This section of the program is activated by inputting the value IO = 3, as was done with the final LRU for the CONUS scenario in the sample problem. This caused the printout of a formatted listing of all of the inputs used for the sample problem. Eight pages of computer printout resulted to provide converage of the entire sequence of sample problem inputs (eleven LRUs and two scenarios) or twenty-two values for each input data factor. Samples of three of the pages of sequenced input printouts are shown in Figure C-10.

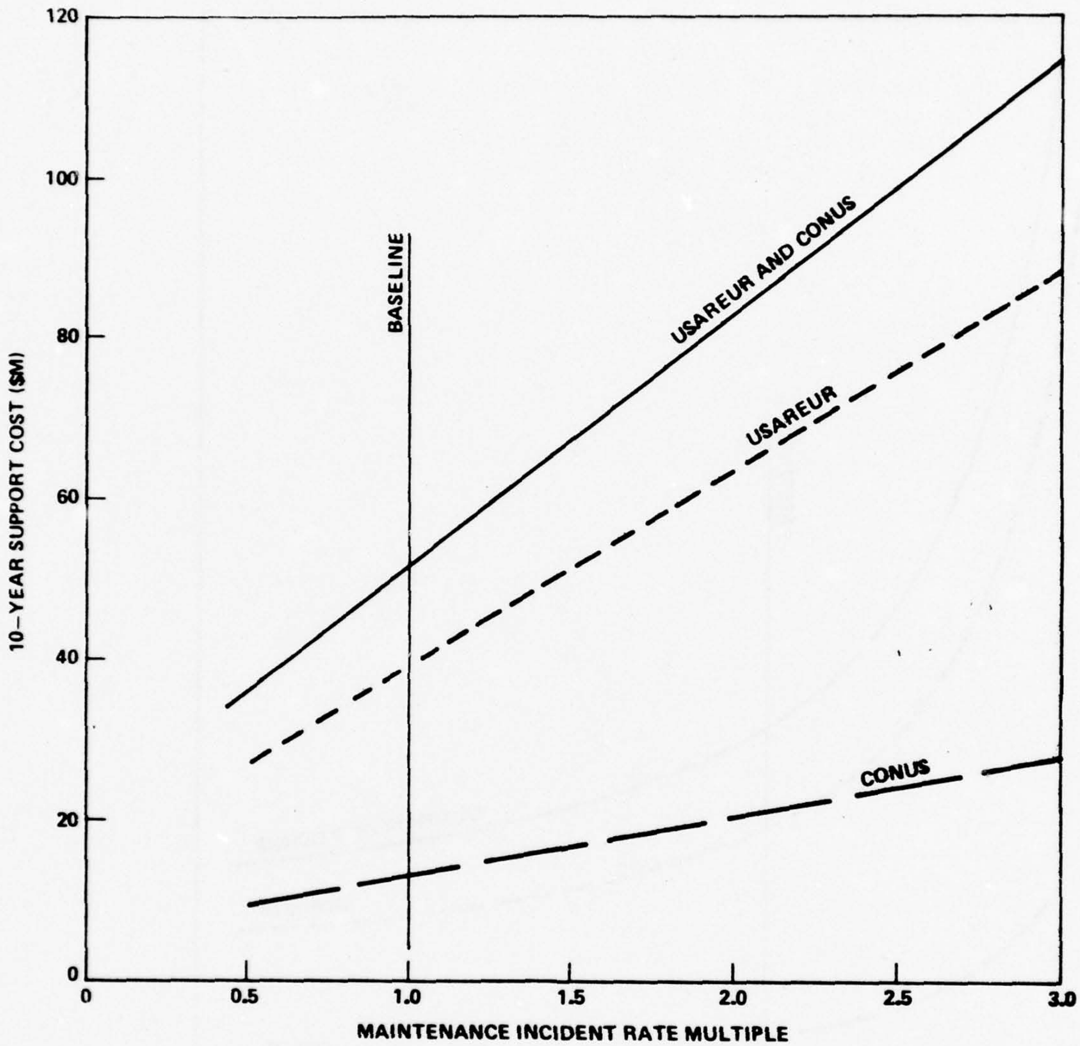

Figure C-8. Effect of maintenance incident rate variation.

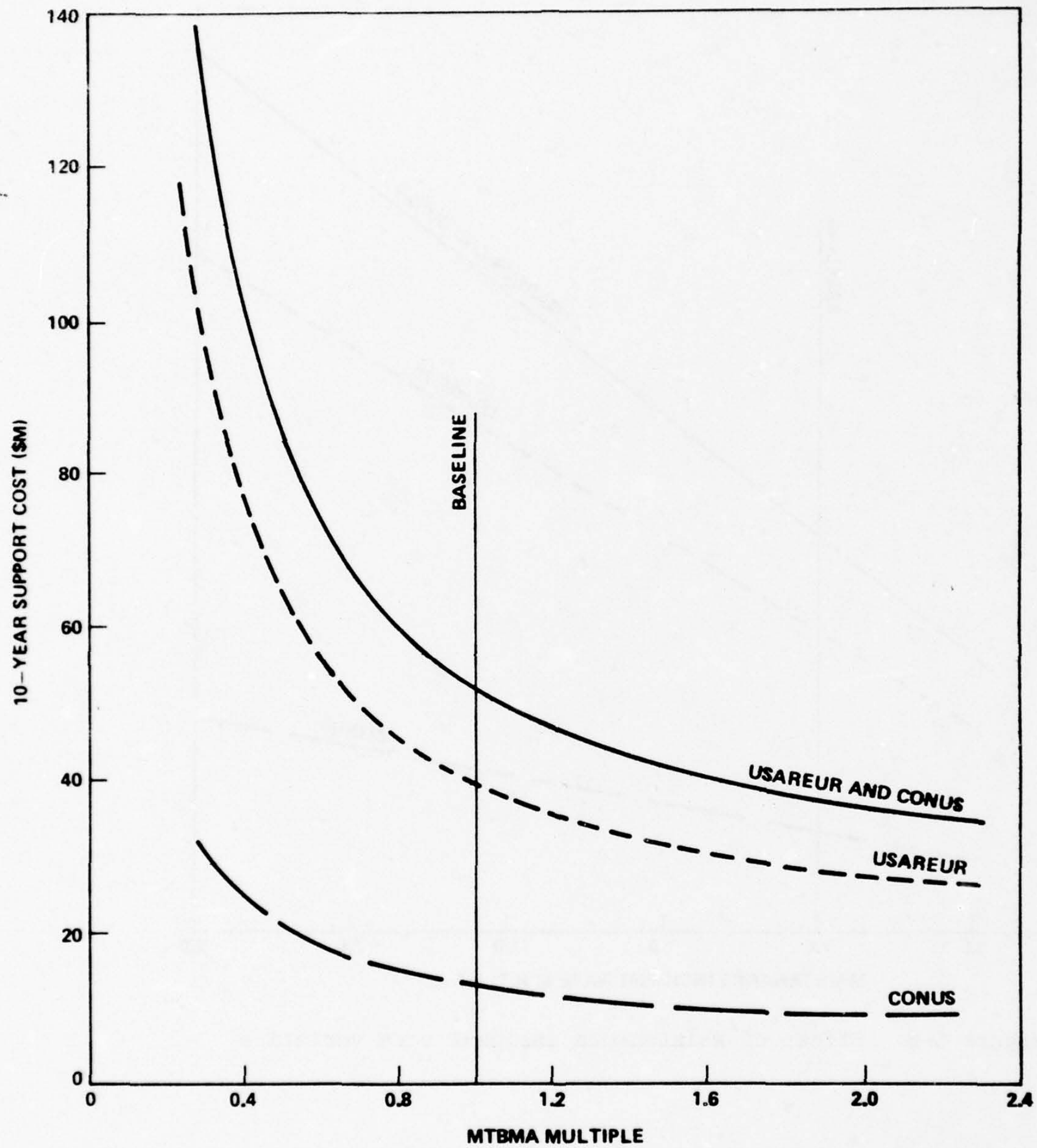

Figure C-9. Effect of MTBMA variation.

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	E	DTF	REPEAT	EE	FN YAT YKWD	HE	HO	HI	HD	FNGF	DTO	DTI
1CLASS 1 LRU NO. 1	0.100E-03	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	60.0	60.0
2CLASS 1 LRU NO. 2	0.100E-03	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	60.0	60.0
3CLASS 1 LRU NO. 3	0.500E-03	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	60.0	60.0
4CLASS 1 LRU NO. 4	0.500E-03	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	60.0	60.0
5CLASS 2 LRU NO. 1	0.210E-02	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	60.0	60.0
6CLASS 2 LRU NO. 2	0.170E-02	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	60.0	60.0
7CLASS 2 LRU NO. 3	0.110E-02	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	60.0	60.0
8CLASS 2 LRU NO. 4	0.100E-02	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	60.0	60.0
9CLASS 2 LRU NO. 5	0.800E-03	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	60.0	60.0
10CLASS 3 LRU NO. 1	0.100E-02	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	60.0	60.0
11CLASS 3 LRU NO. 2	0.130E-02	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	60.0	60.0
12CLASS 1 LRU NO. 1	0.100E-03	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	30.0	30.0
13CLASS 1 LRU NO. 2	0.100E-03	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	30.0	30.0
14CLASS 1 LRU NO. 3	0.500E-03	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	30.0	30.0
15CLASS 1 LRU NO. 4	0.500E-03	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	30.0	30.0
16CLASS 2 LRU NO. 1	0.210E-02	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	30.0	30.0
17CLASS 2 LRU NO. 2	0.170E-02	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	30.0	30.0
18CLASS 2 LRU NO. 3	0.110E-02	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	30.0	30.0
19CLASS 2 LRU NO. 4	0.100E-02	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	30.0	30.0
20CLASS 2 LRU NO. 5	0.800E-03	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	30.0	30.0
21CLASS 3 LRU NO. 1	0.100E-02	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	30.0	30.0
22CLASS 3 LRU NO. 2	0.130E-02	0.0548	1.	1.	0.0.0000.200	1.	1.	1.	1.	0.20	30.0	30.0

	TC	TF	TI	TD	TMO	TMI	TMD	TFR	TIR	TDR	TMOR	TMIR	TMDR	TOMW	TIMW	TOMW	TMOD	TMID	TMDD
1CLASS 1 LRU NO. 1	0.00	0.00	0.25	0.25	0.00	0.00	0.80	0.00	0.50	0.50	0.00	0.00	1.30	0.00	0.50	0.50	0.00	1.00	1.00
2CLASS 1 LRU NO. 2	0.00	0.00	0.25	0.25	0.00	0.00	0.60	0.00	0.50	0.50	0.00	0.00	1.10	0.00	0.50	0.50	0.00	1.00	1.00
3CLASS 1 LRU NO. 3	0.00	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.50	0.50	0.00	0.00	0.90	0.00	0.50	0.50	0.00	1.00	1.00
4CLASS 1 LRU NO. 4	0.00	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.00	1.00	1.00
5CLASS 2 LRU NO. 1	0.00	0.00	2.00	2.00	0.00	0.00	0.50	0.00	2.00	2.00	0.00	0.00	0.90	0.00	0.50	0.50	0.00	1.00	1.00
6CLASS 2 LRU NO. 2	0.00	0.00	1.80	1.80	0.00	0.00	0.50	0.00	1.50	1.50	0.00	0.00	0.90	0.00	0.50	0.50	0.00	1.00	1.00
7CLASS 2 LRU NO. 3	0.00	0.00	0.50	0.50	0.00	0.00	0.40	0.00	1.50	1.50	0.00	0.00	0.80	0.00	0.50	0.50	0.00	1.00	1.00
8CLASS 2 LRU NO. 4	0.00	0.00	0.80	0.80	0.00	0.00	0.30	0.00	1.80	1.80	0.00	0.00	0.60	0.00	0.50	0.50	0.00	1.00	1.00
9CLASS 2 LRU NO. 5	0.00	0.00	1.00	1.00	0.00	0.00	0.10	0.00	1.80	1.80	0.00	0.00	0.40	0.00	0.50	0.50	0.00	1.00	1.00
10CLASS 3 LRU NO. 1	0.00	0.00	0.50	0.50	0.00	0.00	0.30	0.00	1.60	1.60	0.00	0.00	0.60	0.00	0.50	0.50	0.00	1.00	1.00
11CLASS 3 LRU NO. 2	0.00	0.00	1.00	1.00	0.00	0.00	0.75	0.00	3.50	3.50	0.00	0.00	3.40	0.00	0.50	0.50	0.00	1.00	1.00
12CLASS 1 LRU NO. 1	0.00	0.00	0.25	0.25	0.00	0.00	0.80	0.00	0.50	0.50	0.00	0.00	1.30	0.00	0.50	0.50	0.00	1.00	1.00
13CLASS 1 LRU NO. 2	0.00	0.00	0.25	0.25	0.00	0.00	0.60	0.00	0.50	0.50	0.00	0.00	1.10	0.00	0.50	0.50	0.00	1.00	1.00
14CLASS 1 LRU NO. 3	0.00	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.50	0.50	0.00	0.00	0.90	0.00	0.50	0.50	0.00	1.00	1.00
15CLASS 1 LRU NO. 4	0.00	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50	0.00	1.00	1.00
16CLASS 2 LRU NO. 1	0.00	0.00	2.00	2.00	0.00	0.00	0.50	0.00	2.00	2.00	0.00	0.00	0.90	0.00	0.50	0.50	0.00	1.00	1.00
17CLASS 2 LRU NO. 2	0.00	0.00	1.80	1.80	0.00	0.00	0.50	0.00	1.50	1.50	0.00	0.00	0.90	0.00	0.50	0.50	0.00	1.00	1.00
18CLASS 2 LRU NO. 3	0.00	0.00	0.50	0.50	0.00	0.00	0.40	0.00	1.50	1.50	0.00	0.00	0.80	0.00	0.50	0.50	0.00	1.00	1.00
19CLASS 2 LRU NO. 4	0.00	0.00	0.80	0.80	0.00	0.00	0.30	0.00	1.80	1.80	0.00	0.00	0.60	0.00	0.50	0.50	0.00	1.00	1.00
20CLASS 2 LRU NO. 5	0.00	0.00	1.00	1.00	0.00	0.00	0.10	0.00	1.60	1.80	0.00	0.00	0.40	0.00	0.50	0.50	0.00	1.00	1.00
21CLASS 3 LRU NO. 1	0.00	0.00	0.50	0.50	0.00	0.00	0.30	0.00	1.60	1.60	0.00	0.00	0.60	0.00	0.50	0.50	0.00	1.00	1.00
22CLASS 3 LRU NO. 2	0.00	0.00	0.00	1.00	0.00	0.00	0.75	0.00	3.50	3.50	0.00	0.00	3.40	0.00	0.50	0.50	0.00	1.00	1.00

	ED	EDS	DD	DDS	DI	DIS	DO	DDS	SPE	SPEV	SPEVR	SVE	SVR	SVT	SVV	SMF	FINT	ARA
1CLASS 1 LRU NO. 1	141.	141.	9.	9.	2.	2.	1.	1.	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
2CLASS 1 LRU NO. 2	141.	141.	9.	9.	2.	2.	1.	1.	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
3CLASS 1 LRU NO. 3	141.	141.	9.	9.	2.	2.	1.	1.	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
4CLASS 1 LRU NO. 4	141.	141.	9.	9.	2.	2.	1.	1.	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
5CLASS 2 LRU NO. 1	141.	141.	9.	9.	2.	2.	1.	1.	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
6CLASS 2 LRU NO. 2	141.	141.	9.	9.	2.	2.	1.	1.	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
7CLASS 2 LRU NO. 3	141.	141.	9.	9.	2.	2.	1.	1.	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
8CLASS 2 LRU NO. 4	141.	141.	9.	9.	2.	2.	1.	1.	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
9CLASS 2 LRU NO. 5	141.	141.	9.	9.	2.	2.	1.	1.	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
10CLASS 3 LRU NO. 1	141.	141.	9.	9.	1.	1.	1.	1.	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40

Figure C-10. Selected samples of LOCAM 5 printout format for listing of sequence of input data for example problem entire input data set.

11CLASS 3 LRU NO. 2	1.0	3.0	0.0	2.0	17.	17.	0.	30.	30.	60.	30.	0.	0.	336.	64.	38.	20.	30.	30.	30.
12CLASS 1 LRU NO. 1	1.0	3.0	0.0	2.0	17.	0.	17.	30.	30.	30.	30.	0.	0.	336.	56.	30.	12.	30.	30.	30.
13CLASS 1 LRU NO. 2	1.0	3.0	0.0	2.0	17.	0.	17.	30.	30.	30.	30.	0.	0.	336.	56.	30.	12.	30.	30.	30.
14CLASS 1 LRU NO. 3	1.0	3.0	0.0	2.0	17.	0.	17.	30.	30.	30.	30.	0.	0.	336.	56.	30.	12.	30.	30.	30.
15CLASS 1 LRU NO. 4	1.0	3.0	0.0	2.0	17.	0.	17.	30.	30.	30.	30.	0.	0.	336.	56.	30.	12.	30.	30.	30.
16CLASS 2 LRU NO. 1	1.0	3.0	0.0	2.0	17.	0.	17.	30.	30.	30.	30.	0.	0.	336.	56.	30.	12.	30.	30.	30.
17CLASS 2 LRU NO. 2	1.0	3.0	0.0	2.0	17.	0.	17.	30.	30.	30.	30.	0.	0.	336.	56.	30.	12.	30.	30.	30.
18CLASS 2 LRU NO. 3	1.0	3.0	0.0	2.0	17.	0.	17.	30.	30.	30.	30.	0.	0.	336.	56.	30.	12.	30.	30.	30.
19CLASS 2 LRU NO. 4	1.0	3.0	0.0	2.0	17.	0.	17.	30.	30.	30.	30.	0.	0.	336.	56.	30.	12.	30.	30.	30.
20CLASS 2 LRU NO. 5	1.0	3.0	0.0	2.0	17.	0.	17.	30.	30.	30.	30.	0.	0.	336.	56.	30.	12.	30.	30.	30.
21CLASS 3 LRU NO. 1	1.0	3.0	0.0	2.0	17.	0.	17.	30.	30.	30.	30.	0.	0.	335.	56.	30.	12.	30.	30.	30.
22CLASS 3 LRU NO. 2	1.0	3.0	0.0	2.0	17.	0.	17.	30.	30.	30.	30.	0.	0.	336.	56.	30.	12.	30.	30.	30.

	OL(1)	SL(1)	OST(1)	TAT(1)	OL(2)	SL(2)	OST(2)	TAT(2)	OL(3)	SL(3)	OST(3)	TAT(3)	STAT
1CLASS 1 LRU NO. 1	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	30.	127.	60.
2CLASS 1 LRU NO. 2	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	30.	127.	60.
3CLASS 1 LRU NO. 3	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	30.	127.	60.
4CLASS 1 LRU NO. 4	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	30.	127.	60.
5CLASS 2 LRU NO. 1	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	30.	127.	60.
6CLASS 2 LRU NO. 2	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	30.	127.	60.
7CLASS 2 LRU NO. 3	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	30.	127.	60.
8CLASS 2 LRU NO. 4	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	30.	127.	60.
9CLASS 2 LRU NO. 5	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	30.	127.	60.
10CLASS 3 LRU NO. 1	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	30.	127.	60.
11CLASS 3 LRU NO. 2	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	30.	127.	60.
12CLASS 1 LRU NO. 1	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	20.	127.	20.
13CLASS 1 LRU NO. 2	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	20.	127.	20.
14CLASS 1 LRU NO. 3	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	20.	127.	20.
15CLASS 1 LRU NO. 4	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	20.	127.	20.
16CLASS 2 LRU NO. 1	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	20.	127.	20.
17CLASS 2 LRU NO. 2	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	20.	127.	20.
18CLASS 2 LRU NO. 3	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	20.	127.	20.
19CLASS 2 LRU NO. 4	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	20.	127.	20.
20CLASS 2 LRU NO. 5	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	20.	127.	20.
21CLASS 3 LRU NO. 1	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	20.	127.	20.
22CLASS 3 LRU NO. 2	15.	15.	15.	15.	15.	15.	15.	30.	30.	30.	20.	127.	20.

	ZFL	ZU(1)	ZU(2)	ZU(3)	ZU(4)	ZM(1)	ZM(2)	ZM(3)	ZP(1)	ZP(2)	ZP(3)
1CLASS 1 LRU NO. 1	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
2CLASS 1 LRU NO. 2	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
3CLASS 1 LRU NO. 3	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
4CLASS 1 LRU NO. 4	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
5CLASS 2 LRU NO. 1	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
6CLASS 2 LRU NO. 2	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
7CLASS 2 LRU NO. 3	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
8CLASS 2 LRU NO. 4	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
9CLASS 2 LRU NO. 5	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
10CLASS 3 LRU NO. 1	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
11CLASS 3 LRU NO. 2	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
12CLASS 1 LRU NO. 1	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
13CLASS 1 LRU NO. 2	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
14CLASS 1 LRU NO. 3	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
15CLASS 1 LRU NO. 4	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
16CLASS 2 LRU NO. 1	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
17CLASS 2 LRU NO. 2	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
18CLASS 2 LRU NO. 3	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
19CLASS 2 LRU NO. 4	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
20CLASS 2 LRU NO. 5	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
21CLASS 3 LRU NO. 1	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900
22CLASS 3 LRU NO. 2	0.99999000	.50000000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.99999000	.9999900

Figure C-10. (Continued).

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	CALMAN	CALPLB	CALSET	CCAL	CCALP	CCALR	CCSP	CCSPP	CCSPR	CDMAN
1CLASS 1 LRU NO. 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
2CLASS 1 LRU NO. 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
3CLASS 1 LRU NO. 3	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
4CLASS 1 LRU NO. 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
5CLASS 2 LRU NO. 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
6CLASS 2 LRU NO. 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
7CLASS 2 LRU NO. 3	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
8CLASS 2 LRU NO. 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
9CLASS 2 LRU NO. 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
10CLASS 3 LRU NO. 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
11CLASS 3 LRU NO. 2	0.	0.	1.	0.	220000.	2000.	425000.	100000.	1000.	16600.
12CLASS 1 LRU NO. 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
13CLASS 1 LRU NO. 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
14CLASS 1 LRU NO. 3	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
15CLASS 1 LRU NO. 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
16CLASS 2 LRU NO. 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
17CLASS 2 LRU NO. 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
18CLASS 2 LRU NO. 3	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
19CLASS 2 LRU NO. 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
20CLASS 2 LRU NO. 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
21CLASS 3 LRU NO. 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	16600.
22CLASS 3 LRU NO. 2	0.	0.	0.	0.	0.	0.	0.	100000.	1000.	16600.

	CDPMAN	CDPRPN	CORMAN	CGHAN	CGRMAN	CUNMAN	CONTCT	CPUBII	CTCPUB	CTRCAL
1CLASS 1 LRU NO. 1	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
2CLASS 1 LRU NO. 2	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
3CLASS 1 LRU NO. 3	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
4CLASS 1 LRU NO. 4	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
5CLASS 2 LRU NO. 1	16600.	16600.	16600.	16600.	16600.	0.	0.	0.	0.	0.
6CLASS 2 LRU NO. 2	16600.	16600.	16600.	16600.	16600.	0.	0.	0.	0.	0.
7CLASS 2 LRU NO. 3	16600.	16600.	16600.	16600.	16600.	0.	0.	0.	0.	0.
8CLASS 2 LRU NO. 4	16600.	16600.	16600.	16600.	16600.	0.	0.	0.	0.	0.
9CLASS 2 LRU NO. 5	16600.	16600.	16600.	16600.	16600.	0.	0.	0.	0.	0.
10CLASS 3 LRU NO. 1	16600.	16600.	16600.	16600.	16600.	0.	0.	0.	0.	0.
11CLASS 3 LRU NO. 2	16600.	16600.	16600.	16600.	16600.	0.	10.	0.	0.	0.
12CLASS 1 LRU NO. 1	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
13CLASS 1 LRU NO. 2	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
14CLASS 1 LRU NO. 3	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
15CLASS 1 LRU NO. 4	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
16CLASS 2 LRU NO. 1	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
17CLASS 2 LRU NO. 2	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
18CLASS 2 LRU NO. 3	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
19CLASS 2 LRU NO. 4	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
20CLASS 2 LRU NO. 5	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
21CLASS 3 LRU NO. 1	26100.	26100.	16600.	16600.	16600.	0.	0.	0.	0.	0.
22CLASS 3 LRU NO. 2	26100.	26100.	16600.	16600.	16600.	0.	5.	0.	0.	0.

	CI	CII	CPI	CPII	CRI	CRII	CTRI	CTRII	CTRSPT	CUCE
1CLASS 1 LRU NO. 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
2CLASS 1 LRU NO. 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
3CLASS 1 LRU NO. 3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
4CLASS 1 LRU NO. 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
5CLASS 2 LRU NO. 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
6CLASS 2 LRU NO. 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
7CLASS 2 LRU NO. 3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
8CLASS 2 LRU NO. 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
9CLASS 2 LRU NO. 5	1824000.	0.	131500.	0.	6000.	0.	0.	0.	0.	0.00
10CLASS 3 LRU NO. 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
11CLASS 3 LRU NO. 2	0.	1370000.	0.	264000.	0.	7500.	0.	0.	0.	0.00
12CLASS 1 LRU NO. 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
13CLASS 1 LRU NO. 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
14CLASS 1 LRU NO. 3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
15CLASS 1 LRU NO. 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00
16CLASS 2 LRU NO. 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.00

Figure C-10. (Concluded).

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Appendix D. SAMPLE PROBLEM INPUT LISTING

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COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
 USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
  MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
     ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.
THREE LRU CLASSES
JULY 30, 1976
THOUSANDS OF DOLLARS                          .001
   TOTAL                                                                     11
CLASS 1 LRU NO. 1
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 &L OTF=.0548,E=.0001,P=3.,PP=20.,TIMW=.5,TDMW=.5,RDD=30.,WU=7.5,WM=.1,
 WP=.05,CUBEU=.12,CUBEM=.005,CUBEP=.003,CDMAN=16600.,CDRMAN=16600.,
 CGMAN=16600.,CGRMAN=16600.,WO=100.,WI=100.,WD=100.,ED=141.,IO=0,
 JTED=2,CDID=.33,CDDI=.33,CDFD=.63,TI=.25,TIR=.5,TD=.25,TDR=.5,
 CTRA=2350.,ARA=.4,CSDEP=.1,DAJQL=.98,CUP=988.,CMP=500.,CPP=3.,
 YMWD=.2,TMID=1.,TMDD=1.,CDPMAN=26100.,CDPRMN=26100.,ZI=0.,GT=1.,DTO=60.,
 CEN=1077.,CAD=436.,TMD=.8,TMDR=1.3,DI=2.,TDMAN=2.,TDRMAN=2.,DTI=60.,
 TOI=17.,TIO=0.,TDI=60.,TID=30.,NU=1,IS=3,CKIT=148.,TAYZ=2*1.,8*0.,NA=4,
 FTU=64.,FTM=36.,FTP=20.,CRU=835.,CRM=835.,CRP=835.,WTKIT=1.,TUMD=336.,
 WOM=40.,WIM=40.,WDM=40.,WOR=40.,WIR=40.,WCR=40.,YD=1.,YP=1.,YR=10.,
 TUMO=0.,INHIB=0,YZ=-1.5,CFTD=1.,QMU=20.,QMM=50.,QMP=100.,CKUO=.85,
 CKUI=.85,CKUD=.85,CKMO=.85,CKMI=.85,CKMD=.85,CKPO=.85,CKPI=.85,
 CKPD=.85,TGMAN=2.,TGRMAN=2.,TDPMI=2.,TDPRI=2.,TDPMII=2.,TDPRII=2.,
 FI=.1,FII=.1,OD=9.,ODS=9.,FNSP=.5,EVOR=0.,EDS=141.,FNGF=.2,DIS=2.,
 AYZP=1.,RIO=30.,ROI=17.,SMO=0.,SMI=0.,SUO=0.,SUI=0.,TATE=3.,TOE=2.,
 TRC=1.,TUMI=0.,YAT=0.,H=4*1.,UL=15.,15.,30.,OST=15.,15.,30.,STAT=60.,
 SL=15.,15.,30.,TAT=15.,30.,127.,HPM=30.,HPP=30.,HPU=30.,ZU(1)=.5,
 GT=1. &END
CLASS 1 LRU NO. 2
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 &L IO=0,E=.0001,CUP=988.,CMP=500.,WP=.1,CUBEP=.005,TMD=.6,TMDR=1.1,
 WU=4.5,WM=.2,CUBEU=.15,CUBEM=.015,P=3.,PP=30.,CPP=2.5,GT=1.
 &END
CLASS 1 LRU NO. 3
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 &L E=.0005,P=2.,WP=.1,TI=.25,TIR=.5,TD=.25,TDR=.5,TMD=.5,TMDR=.9,
 WU=3.,WM=.5,CUBEU=.1,CUBEM=.01,CUBEP=.005,CUP=988.,CMP=500.,PP=20.,
 CPP=7.,GT=1.
 &END
CLASS 1 LRU NO. 4
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 &L E=.0005,P=2.,PP=0.,TI=.25,TIR=.5,TD=.25,TDR=.5,TMD=0.,TMDR=0.,
 WU=3.,WM=.5,WP=0.,CUBEU=.1,CUBEM=.01,CUBEP=0.,CMP=450.,CPP=0.,
 CUP=741.,GT=1.,IO=1,CKIT=111.
 &END
CLASS 2 LRU NO. 1
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 &L E=.0021,ZI=.5,PP=50.,WU=40.,WM=2.,WP=.1,CUBEU=.75,CUBEM=.02,P=15.,
 TI=2.,TD=2.,TMD=.5,TMDR=.9,TDR=2.,TIR=2.,CUBEP=.005,CUP=57730.,
 CMP=2080.,CPP=12.5,IO=0,CDPMAN=16600.,CDPRMN=16600.,GS=.85,GT=.15,
 TAYZ=1.,0.,1.,7*0.,
 CKIT=5773.,WTKIT=10.
 &END
CLASS 2 LRU NO. 2
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 &L E=.0017,PP=40.,TI=1.8,TD=1.8,P=10.,CMP=1126.,CPP=18.,TIR=1.5,WU=26.,
 WM=1.5,WP=.08,CUBEU=.7,CUP=17513.,TMD=.5,TMDR=.9,TDR=1.5,GS=.85,GT=.15,
 CKIT=1761.
 &END
```

```
CLASS 2 LRU NO. 3
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 &L E=.0011,P=8.,TI=.5,TD=.5,WU=36.,WM=2.,WP=.1,CUBEU=.75,CPP=10.5,
 TMD=.4,TMDR=.8,CUP=18827.,PP=40.,CMP=1500.,GS=.85,GT=.15,CKIT=1883.
 &END
CLASS 2 LRU NO. 4
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 &L TI=.8,TIR=1.8,TD=.8,TDR=1.8,E=.001,TMD=.3,THDR=.6,CUP=12250.,P=4.,
 WU=40.,WM=2.,WP=.1,CUBEU=.75,CUBEM=.02,CUBEP=.005,PP=40.,CMP=1360.,
 CPP=9.,GS=.85,GT=.15,CKIT=1225.
 &END
CLASS 2 LRU NO. 5
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 &L TI=1.,TIR=1.8,TD=1.,TDR=1.8,TMD=.1,TMDR=.4,WU=36.,CKIT=500.,
 CUP=5000.,P=4.,PP=40.,CMP=1000.,CPP=6.,E=.0008,ID=1,
 CI=1824000.,CPI=131500.,CRI=6000.,ETI=1.,GS=.85,GT=.15
 &END
CLASS 3 LRU NO. 1
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 &L EE=1.,E=.001,P=12.,PP=50.,TI=.5,TIR=1.6,TD=.5,TDR=1.6,TMD=.3,
 TMDR=.6,WU=30.,WM=1.5,WP=.08,CUBEU=1.,CUBEM=.05,CUBEP=.01,CUP=27716.,
 TAYZ=1.,2*0.,7*1.,
 CPI=0.,CRI=0.,
 CMP=1610.,CPP=6.,          ZI=.7,GS=.7,GT=.3,DI=1.,CKIT=2772,,DIS=1.
 &END
CLASS 3 LRU NO. 2
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 &L NU=-1,IS=1,          ETII=1.,E=.0013,P=13.,PP=40.,TI=1.,ID=2,
 CUBEU=15.,CUBEM=.5,CUBEP=.05,WP=.5,CII=1370000.,CRII=7500.,
 CI=0.,CPI=0.,CRI=0.,TMDR=3.4,CPP=11.,CPII=264000.,
 CCSP=425000.,CCSPP=100000.,          CCSPR=1000.,EACSP=1.,
 TD=1.,TMD=.75,CMP=2500.,TDR=3.5,TIR=3.5,WM=15.,CUP=75262.,WU=150.,
 EACAL=1.,CCALP=220000.,CALSET=1.,CCALR=2000.,ETI=1.,DI=1.,
 CONTCT=10.,
 ZI=.7,GS=.7,GT=.3,CKIT=7526.,WTKIT=30.,DIS=1.
 &END
CLASS 1 LRU NO. 1
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 &L  DTO=30.,DTI=30.,ED=40.,EDS=40.,OD=4.,ODS=4., DI=4.,DIS=4.,TDI=0.,TID=17.,
 TOI=30.,FTU=56.,FTM=30.,FTP=12.,DST(3)=20.,STAT=20.,CEN=451.,CAD=170.,
 GT=1.,
 CDFD=.33
 &END
CLASS 1 LRU NO. 2
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 &L ID=0,E=.0001,CUP=988.,CMP=500.,WP=.1,CUBEP=.005,TMD=.6,TMDR=1.1,
 WU=4.5,WM=.2,CUBEU=.15,CUBEM=.015,P=3.,PP=30.,CPP=2.5,GT=1.
 &END
CLASS 1 LRU NO. 3
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 &L E=.0005,P=2.,WP=.1,TI=.25,TIR=.5,TD=.25,TDR=.5,TMD=.5,TMDR=.9,
 WU=3.,WM=.5,CUBEU=.1,CUBEM=.01,CUBEP=.005,CUP=988.,CMP=500.,PP=20.,
 CPP=7.,GT=1.
 &END
CLASS 1 LRU NO. 4
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 &L E=.0005,P=2.,PP=1.,TI=.25  IR=.5,TD=.25,TDR=.5,TMD=0.,TMDR=0.,
 WU=3.,WM=.5,WP=0.,CUBEU=.1,CUBEM=.01,CUBEP=0.,CMP=450.,CPP=0.,
 PP=0.,
 CUP=741.,GT=1.,ID=2,CKIT=111.
 &END
CLASS 2 LRU NO. 1
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 &L E=.0021,ZI=.5,PP=50.,WU=40.,WM=2.,WP=.1,CUBEU=.75,CUBEM=.02,P=15.,
 TI=2.,TD=2.,TMD=.5,TMDR=.9,TDR=2.,TIR=2.,CUBEP=.005,CUP=57730.,
 TAYZ=1.,0.,1.,7*0.,
```

```
 CMP=2080.,CPP=12.5,GS=.85,GT=.15,CKIT=5773.,WTKIT=10.
 &END
CLASS 2 LRU NO. 2
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 &L E=.0017,PP=40.,TI=1.8,TD=1.8,P=10.,CMP=1126.,CPP=18.,TIR=1.5,
 WU=26.,WM=1.5,WP=.08,CUBEU=.7,CUP=17613.,TMD=.5,TMDR=.9,TDR=1.5,
 GS=.85,GT=.15,IO=0,CKIT=1761.
 &END
CLASS 2 LRU NO. 3
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 &L E=.0011,P=8.,TI=.5,TD=.5,WU=36.,WM=2.,WP=.1,CUBEU=.75,CPP=10.5,
 TMD=.4,TMDR=.8,CUP=18827.,PP=40.,CMP=1500.,GS=.85,GT=.15,CKIT=1883.
 &END
CLASS 2 LRU NO. 4
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 &L TI=.8,TIR=1.8,TD=.8,TDR=1.8,F=.001,TMD=.3,TMDR=.6,CUP=12250.,P=4.,
 WU=40.,WM=2.,WP=.1,CUBEU=.75,CUBEM=.02,CUBEP=.005,PP=40.,CMP=1360.,
 CPP=9.,GS=.85,GT=.15,CKIT=1225.
 &END
CLASS 2 LRU NO. 5
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 &L TI=1.,TIR=1.8,TD=1.,TDR=1.8,TMD=.1,TMDR=.4,WU=36.,IO=1,
 CUP=5000.,P=4.,PP=40.,CMP=1000.,CPP=6.,E=.0008,CKIT=500.,
 CI=0.,CPI=131500.,CRI=6000.,ETI=1.,GS=.85,GT=.15
 &END
CLASS 3 LRU NO. 1
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 &L E=.001,P=12.,PP=50.,TI=.5,TIR=1.6,TD=.5,TDR=1.6,TMD=.3,TMDR=.6,
 WU=30.,WM=1.5,WP=.08,CUBEU=1.,CUBEM=.05,CUBEP=.01,CKIT=2772.,
 TAYZ=1.,2*0.,7*1.,
 CPI=0.,CRI=0.,
 CUP=27716.,CMP=1610.,CPP=6.,ZI=0.,          GT=1.
 &END
CLASS 3 LRU NO. 2
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 &L NU=-1,IS=1,          ETII=1.,E=.0013,P=13.,PP=40.,TI=0.,WTKIT=30.,
 CUBEU=15.,CUBEM=.5,CUBEP=.05,WP=.5,CII=0.,CRII=7500.,CKIT=7526.,IO=2,
 CI=0.,CPI=0.,CRI=0.,ZI=0.,TMDR=3.4,CPP=11.,CPII=264000.,
 CCSP=0.,CCSPP=100000.,CONTCT=0.,CCSPR=1000.,EACSP=1.,ETI=1.,
 IO=3,
 NU=-3,
 CONTCT=5.,
 TD=1.,TMD=.75,CMP=2500.,TDR=3.5,TIR=3.5,WM=15.,CUP=75262.,WU=150.,GT=1.
 &END
SENSY ON FAIL RATE
FAILURE RATE IS 2-AND 3-TIMES BASELINE.
 &L SENSY=1.,2.,4.,76.,2.,3.,
 INHIB=1,IFLAG=1 &END
END
FINIS
 &L NU=-4 &END
```

Appendix E. SAMPLE PROBLEM OUTPUT LISTING EXCERPT

The output listing of the sample problem described in Appendix C contains results data in six sections:

1) LRU data.
2) Theater totals data.
3) Summary LRU totals data.
4) Grand Total data.
5) Sequenced listing of input data.
6) Sensitivity and summary data.

The LRU data comprise 22 computer numbered pages of LRU results. The theater totals data comprise two numbered pages of output, one for each theater (USAREUR is page 12 and CONUS is page 24). Pages 25 through 35 contain the summary LRU totals data and page 36 shows the grand cost total data for the two scenarios. Page 12, 24, and 36 are contained in Appendix C (Figures C-4, C-5, and C-6). The sequenced listing of input data consists of eight pages covering the entire sequence of the sample problem inputs (eleven LRUs and two scenarios; Figure C-10 presents three of the eight pages). Finally, eleven sensitivity and summary data pages are produced. These are numbered by the computer from page 37 through page 47. Appendix E contains excerpts of this total printout listing. The first six pages of the listing (LRU data), six pages of the summary LRU totals data (pages 25 through 30) from the output listing, and the last four pages (Sensitivity and Summary data) are provided. These pages, along with the computer printouts reproduced in Appendix C, are sufficient to determine if the sample problem using LOCAM 5 is running correctly on the computer.

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                    COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                     USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                      MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                        ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 1 LRU NO. 1                                                       ANALYSIS - THREE LRU CLASSES
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS          DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL
EACH      CUM
   140.      140.     THOUSANDS OF DOLLARS             AVAILABILITY=  .999993  INHERENT=  .999993
PRIME      T.E.       TE SPACE MANPOWER  SUPPLY    ORDERING  STORAGE   S.ADMIN  SHIPPING  TOTAL
     0.        0.         0.         0.       63.        0.        0.       76.        1.     140.

PROVISION       INITIAL BUY        REORDER BUY        CONSUMED          RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART
  13.     3.    1.  154.   157.  158.   20.   50.  100.    0.    0.    2.   13.    3.    0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA
                DIRECT                                        GENERAL                                     DEPOT
   T.E.                             REPAIR      T.E.                             REPAIR      T.E.                                 REPAIR
   EACH        CUM       EACH        CUM        EACH        CUM       EACH        CUM        EACH        CUM       EACH          CUM
  0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000       .0045       .0045      .0051        .0051
             0.0000                0.0000                0.0000                0.0000                   .0045                   .0051

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
   140.      140.     MANPOWER        0.     DELTA          0.     PV DELTA        0.
INITIAL PROVISION QUANTITIES OF
                  UNITS                                                     MODULES                                            PARTS
  EQPT.      DIRECT     GENERAL      DEPOT          DIRECT     GENERAL      DEPOT          DIRECT      GENERAL          DEPOT
    0.          9.          4.          0.              0.          0.          3.             0.           0.              1.
COST OF INITIAL PROVISION                                                  RESIDUAL
          EQPT.       DIRECT       GENERAL        DEPOT        TOTAL
UNIT        0.          9.            4.            0.          13.        13.
MODULE                  0.            0.            5.           5.         5.
PART                    0.            0.            0.           0.         0.
```

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                         COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                          USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                           MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                             ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 1 LRU NO. 2                                                                  ANALYSIS - THREE LRU CLASSES
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS                       DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL
EACH      CUM
    167.      307.     THOUSANDS OF DOLLARS                 AVAILABILITY=  .999993  INHERENT=  .999993
PRIME     T.E.       TE SPACE MANPOWER  SUPPLY     ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
       0.       0.        0.       0.        63.        0.        0.      183.        0.      167.

PROVISION        INITIAL BUY        REORDER BUY         CONSUMED          RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART
   13.    3.    1.  154.  157.  158.   20.   50.  100.    0.    0.    1.   13.    3.    0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA
              DIRECT                                         GENERAL                                   DEPOT
     T.E.                          REPAIR     T.E.                                REPAIR     T.E.                               REPAIR
     EACH       CUM       EACH       CUM      EACH       CUM       EACH       CUM      EACH       CUM       EACH       CUM
    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    .0043     .0087     .0049     .0100
              0.0000              0.0000              0.0000              0.0000              .0087               .0100


EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
    167.      307.     MANPOWER        0.    DELTA          0.    PV DELTA       0.
INITIAL PROVISION QUANTITIES OF
                     UNITS                                                 MODULES                                       PARTS
  EQPT.    DIRECT    GENERAL      DEPOT          DIRECT    GENERAL      DEPOT          DIRECT    GENERAL      DEPOT
     0.       9.        4.          0.              0.         0.         3.              0.         0.          1.
COST OF INITIAL PROVISION                                                  RESIDUAL
        EQPT.        DIRECT      GENERAL       DEPOT       TOTAL
UNIT       0.           9.          4.          0.          13.         13.
MODULE                  0.          0.          5.           5.          5.
PART                    0.          0.          0.           0.          0.
```

COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 1 LRU NO. 3
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS

ANALYSIS - THREE LRU CLASSES
DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL

EACH	CUM	
216.	523.	THOUSANDS OF DOLLARS

AVAILABILITY= .999967 INHERENT= .999967

PRIME	T.E.	TE SPACE	MANPOWER	SUPPLY	ORDERING	STORAGE	S.ADMIN	SHIPPING	TOTAL
0.	0.	0.	0.	143.	1.	0.	71.	1.	216.

PROVISION UNIT	MODULE	PART	INITIAL BUY UNIT	MODULE	PART	REORDER BUY UNIT	MODULE	PART	CONSUMED UNIT	MODULE	PART	RESIDUAL UNIT	MODULE	PART
59.	24.	2.	200.	224.	226.	20.	50.	100.	0.	0.	15.	59.	24.	0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA

DIRECT T.E. EACH	CUM	EACH	REPAIR CUM	GENERAL T.E. EACH	CUM	EACH	REPAIR CUM	DEPOT T.E. EACH	CUM	EACH	REPAIR CUM
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.0078	.0166	.0106	.0206
	0.0000		0.0000		0.0000		0.0000		.0166		.0206

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL

EACH	CUM						
216.	523.	MANPOWER	0.	DELTA	0.	PV DELTA	0.

INITIAL PROVISION QUANTITIES OF

EQPT.	UNITS DIRECT	GENERAL	DEPOT	MODULES DIRECT	GENERAL	DEPOT	PARTS DIRECT	GENERAL	DEPOT
0.	27.	14.	18.	0.	0.	24.	0.	0.	2.

COST OF INITIAL PROVISION

	EQPT.	DIRECT	GENERAL	DEPOT	TOTAL	RESIDUAL
UNIT	0.	27.	14.	18.	58.	58.
MODULE		0.	0.	24.	24.	24.
PART		0.	0.	0.	0.	0.

COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 1 LRU NO. 4 — ANALYSIS - THREE LRU CLASSES
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS — DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL

EACH	CUM	
127.	650.	THOUSANDS OF DOLLARS

AVAILABILITY= .999967 INHERENT= .999967

PRIME	T.E.	TE SPACE	MANPOWER	SUPPLY	ORDERING	STORAGE	S.ADMIN	SHIPPING	TOTAL
0.	0.	0.	0.	110.	0.	0.	16.	1.	127.

PROVISION			INITIAL BUY			REORDER BUY			CONSUMED			RESIDUAL		
UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART
59.	24.	24.	280.	224.	248.	20.	50.	100.	0.	0.	315.	59.	24.	0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA

DIRECT				GENERAL				DEPOT			
T.E. EACH	CUM	EACH	REPAIR CUM	T.E. EACH	CUM	EACH	REPAIR CUM	T.E. EACH	CUM	EACH	REPAIR CUM
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.0058	.0224	.0070	.0276
	0.0000		0.0000		0.0000		0.0000		.0224		.0276

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL

EACH	CUM						
127.	650.	MANPOWER	0.	DELTA	0.	PV DELTA	0.

INITIAL PROVISION QUANTITIES OF

	UNITS			MODULES			PARTS		
EQPT.	DIRECT	GENERAL	DEPOT	DIRECT	GENERAL	DEPOT	DIRECT	GENERAL	DEPOT
0.	27.	14.	18.	0.	0.	24.	0.	0.	24.

COST OF INITIAL PROVISION

	EQPT.	DIRECT	GENERAL	DEPOT	TOTAL	RESIDUAL
UNIT	0.	20.	10.	13.	44.	44.
MODULE		0.	0.	22.	22.	22.
PART		0.	0.	0.	0.	0.

COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

ANALYSIS - THREE LRU CLASSES
DATE - JANUARY 2,1977

UNIT - CLASS 2 LRU NO. 1
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS

PRESENT VALUE COST TOTAL

EACH	CUM	
11096.	11746.	THOUSANDS OF DOLLARS

AVAILABILITY= .999862 INHERENT= .999862

PRIME	T.E.	TE SPACE	MANPOWER	SUPPLY	ORDERING	STORAGE	S.ADMIN	SHIPPING	TOTAL
0.	0.	0.	0.	10854.	6.	0.	223.	13.	11096.

PROVISION			INITIAL BUY			REORDER BUY			CONSUMED			RESIDUAL		
UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART
129.	9.	2.	270.	279.	281.	20.	50.	100.	0.	0.	26.	129.	9.	0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA

DIRECT				GENERAL				DEPOT			
T.E. EACH	CUM	EACH	REPAIR CUM	T.E. EACH	CUM	EACH	REPAIR CUM	T.E. EACH	CUM	EACH	REPAIR CUM
0.0000	0.0000	0.0000	0.0000	.0181	.0181	.0181	.0181	.0174	.0398	.0240	.0516
	0.0000		0.0000		.0181		.0181		.0398		.0516

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL

EACH	CUM	MANPOWER		DELTA		PV DELTA	
11096.	11746.		0.		0.		0.

INITIAL PROVISION QUANTITIES OF

	UNITS			MODULES			PARTS		
EQPT.	DIRECT	GENERAL	DEPOT	DIRECT	GENERAL	DEPOT	DIRECT	GENERAL	DEPOT
0.	99.	18.	12.	0.	2.	7.	0.	0.	2.

COST OF INITIAL PROVISION

	EQPT.	DIRECT	GENERAL	DEPOT	TOTAL	RESIDUAL
UNIT	0.	5715.	1039.	693.	7447.	7447.
MODULE		0.	62.	218.	281.	281.
PART		0.	0.	1.	1.	0.

COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 2 LRU NO. 2 — ANALYSIS - THREE LRU CLASSES
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS — DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL

EACH	CUM	
3032.	14778.	THOUSANDS OF DOLLARS

AVAILABILITY= .999888 INHERENT= .999888

PRIME	T.E.	TE SPACE	MANPOWER	SUPPLY	ORDERING	STORAGE	S.ADMIN	SHIPPING	TOTAL
0.	0.	0.	0.	2850.	4.	0.	169.	9.	3032.

PROVISION			INITIAL BUY			REORDER BUY			CONSUMED			RESIDUAL		
UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART
105.	11.	2.	246.	257.	259.	20.	50.	100.	0.	0.	27.	105.	11.	0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA

DIRECT				GENERAL				DEPOT			
T.E. EACH	CUM	EACH	REPAIR CUM	T.E. EACH	CUM	EACH	REPAIR CUM	T.E. EACH	CUM	EACH	REPAIR CUM
0.0000	0.0000	0.0000	0.0000	.0135	.0315	.0115	.0295	.0139	.0537	.0185	.0701
	0.0000		0.0000		.0315		.0295		.0537		.0701

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL

EACH	CUM						
3032.	14778.	MANPOWER	0.	DELTA	0.	PV DELTA	0.

INITIAL PROVISION QUANTITIES OF

	UNITS			MODULES			PARTS		
EQPT.	DIRECT	GENERAL	DEPOT	DIRECT	GENERAL	DEPOT	DIRECT	GENERAL	DEPOT
0.	81.	14.	10.	0.	2.	9.	0.	0.	2.

COST OF INITIAL PROVISION

	EQPT.	DIRECT	GENERAL	DEPOT	TOTAL	RESIDUAL
UNIT	0.	1427.	247.	176.	1849.	1849.
MODULE		0.	23.	101.	124.	124.
PART		0.	0.	1.	1.	0.

```
ARA    = 3.9999998E-01, AYZP   = 1.0000000E 00, CAD    = 1.7000000E 02, CALMAN = 0.0000000E 00,
CALPUB = 0.0000000E 00, CALSET = 0.0000000E 00, CCAL   = 0.0000000E 00, CCALP  = 0.0000000E 00,
CCALR  = 0.0000000E 00, CCSP   = 0.0000000E 00, CCSPP  = 0.0000000E 00, CCSPR  = 0.0000000E 00,
CDDI   = 3.2999998E-01, CDEM   = 0.0000000E 00, CDFD   = 3.2999998E-01, CDID   = 3.2999998E-01,
CDIO   = 0.0000000E 00, CDMAN  = 1.6600000E 04, CDME   = 0.0000000E 00, CDOI   = 0.0000000E 00,
CDPMAN = 2.6100000E 04, CDPPMN = 2.6100000E 04, CDRMAN = 1.6600000E 04, CEN    = 4.5100000E 02,
CEND   = 0.0000000E 00, CFTD   = 1.0000000E 00, CGMAN  = 1.6600000E 04, CGRMAN = 1.6600000E 04,
CI     = 0.0000000E 00, CII    = 0.0000000E 00, CKIT   = 5.7730000E 03, CKMD   = 8.4999996E-01,
CKMI   = 8.4999996E-01, CKMD   = 8.4999996E-01, CKPD   = 8.4999996E-01, CKPI   = 8.4999996E-01,
CKPD   = 8.4999996E-01, CKUD   = 8.4999996E-01, CKUE   = 0.0000000E 00, CKUI   = 8.4999996E-01,
CKUD   = 8.4999996E-01, CLRUPG = 0.0000000E 00, CMODPG = 0.0000000E 00, CMP    = 2.0800000E 03,
CONMAN = 0.0000000E 00, CONTCT = 0.0000000E 00, CPE    = 0.0000000E 00, CPI    = 0.0000000E 00,
CPII   = 0.0000000E 00, CPP    = 1.2500000E 01, CPUBII = 0.0000000E 00, CRI    = 0.0000000E 00,
CRII   = 0.0000000E 00, CRM    = 8.3500000E 02, CRP    = 8.3500000E 02, CRU    = 8.3500000E 02,
CSDEP  = 9.9999964E-02, CSDSU  = 0.0000000E 00, CSGSU  = 0.0000000E 00, CTCPUB = 0.0000000E 00,
CTRA   = 2.3500000E 03, CTRCAL = 0.0000000E 00, CTRI   = 0.0000000E 00, CTRII  = 0.0000000E 00,
CTRSPT = 0.0000000E 00, CUBEM  = 2.0000000E-02, CUREP  = 4.9999999E-03, CUBEU  = 7.5000000E-01,
CUCE   = 0.0000000E 00, CUP    = 5.7730000E 04, DADQL  = 9.7999996E-01, DD     = 1.0000000E 00,
DDS    = 1.0000000E 00, DI     = 4.0000000E 00, DIS    = 4.0000000E 00, E      = 2.0999999E-03,
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EVDR   = 1.0000000E 00, EVDT   = 0.0000000E 00, EVIM   = 1.0000000E 00, EVIR   = 1.0000000E 00,
EVIT   = 0.0000000E 00, EVOM   = 1.0000000E 00, EVOR   = 0.0000000E 00, EVOT   = 0.0000000E 00,
FI     = 9.9999964E-02, FII    = 9.9999964E-02, FINT   = 0.0000000E 00, FMD    = 1.0000000E 00,
FMI    = 1.0000000E 00, FMO    = 1.0000000E 00, FN     = 0.0000000E 00, FNGF   = 1.9999999E-01,
FNSP   = 5.0000000E-01, FSA    = 0.0000000E 00, FTI    = 0.0000000E 00, FTII   = 0.0000000E 00,
FTM    = 3.0000000E 01, FTP    = 1.2000000E 01, FTU    = 5.6000000E 01, FUD    = 1.0000000E 00,
FUI    = 1.0000000E 00, FUU    = 1.0000000E 00, HPM    = 3.0000000E 01, HPP    = 3.0000000E 01,
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QTD    = 0.0000000E 00, QTE    = 0.0000000E 00, QTI    = 0.0000000E 00, QTMD   = 0.0000000E 00,
QTMI   = 0.0000000E 00, QTMO   = 0.0000000E 00, QTO    = 0.0000000E 00, QTPD   = 0.0000000E 00,
QTPI   = 0.0000000E 00, QTPO   = 0.0000000E 00, RDD    = 3.0000000E 01, REPEAT = 1.0000000E 00,
RID    = 3.0000000E 01, ROI    = 1.7000000E 01, SMD    = 0.0000000E 00, SMF    = 0.0000000E 00,
SMI    = 0.0000000E 00, SMO    = 0.0000000E 00, SPE    = 0.0000000E 00, SPEV   = 1.0000000E 00,
SPEVR  = 1.0000000E 00, SUD    = 0.0000000E 00, SUI    = 0.0000000E 00, SUO    = 0.0000000E 00,
SVE    = 0.0000000E 00, SVR    = 0.0000000E 00, SVT    = 0.0000000E 00, SVV    = 0.0000000E 00,
TALMAN = 0.0000000E 00, TATE   = 3.0000000E 00, TC     = 0.0000000E 00, TD     = 2.0000000E 00,
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TDRMAN = 2.0000000E 00, TED    = 0.0000000E 00, TF     = 0.0000000E 00, TFR    = 0.0000000E 00,
TGMAN  = 2.0000000E 00, TGRMAN = 2.0000000E 00, TI     = 2.0000000E 00, TID    = 3.0000000E 01,
TIMW   = 5.0000000E-01, TIO    = 1.7000000E 01, TIR    = 2.0000000E 00, THD    = 5.0000000E-01,
TMOD   = 1.0000000E 00, TMOP   = 8.9999998E-01, THI    = 0.0000000E 00, TMID   = 1.0000000E 00,
TMIR   = 0.0000000E 00, THU    = 0.0000000E 00, TMOD   = 0.0000000E 00, TMOR   = 0.0000000E 00,
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WD     = 1.0000000E 02, WDM    = 4.0000000E 01, WDR    = 4.0000000E 01, WI     = 1.0000000E 02,
WIM    = 4.0000000E 01, WIR    = 4.0000000E 01, WM     = 2.0000000E 00, WO     = 1.0000000E 02,
WOM    = 4.0000000E 01, WOR    = 4.0000000E 01, WP     = 9.9999964E-02, WTKIT  = 1.0000000E 01,
WU     = 4.0000000E 01, YAT    = 0.0000000E 00, YD     = 1.0000000E 00, YHWD   = 1.9999999E-01,
YP     = 1.0000000E 00, YR     = 1.0000000E 01, YZ     =-1.5000000E 00, ZFL    = 9.9998999E-01,
ZI     = 5.0000000E-01, ZO     = 0.0000000E 00, EACAL  = 0.0000000E 00, EACSP  = 0.0000000E 00,
ETI    = 0.0000000E 00, ETII   = 0.0000000E 00, GA     = 0.0000000E 00, GB     = 0.0000000E 00,
GD     = 0.0000000E 00, GE     = 0.0000000E 00, GF     = 0.0000000E 00, GG     = 0.0000000E 00,
GH     = 0.0000000E 00, GL     = 0.0000000E 00, GM     = 0.0000000E 00, GN     = 0.0000000E 00,
GO     = 0.0000000E 00, GP     = 0.0000000E 00, GQ     = 0.0000000E 00, GR     = 0.0000000E 00,
GS     = 8.4999996E-01, GT     = 1.4999998E-01, H      = 1.0000000E 00,    1.0000000E 00,   1.0000000E 00,
         1.0000000E 00, ID     =             2, INHIB  =             0, IPAGE  =           -16,
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BEST AVAILABLE COPY

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IS    =              3, ITR   =              0, JTED  =              2, NA    =              4,
NB    =              1, ND    =              1, NU    =              1, OL    =  1.5000000E 01,  1.5000000E 01,
        3.0000000E 01, DST   =  1.5000000E 01,  1.5000000E 01,  2.0000000E 01, SL    =  1.5000000E 01,
        1.5000000E 01,  3.0000000E 01, TAT   =  1.5000000E 01,  3.0000000E 01,  1.2700000E 02,
TAYZ  = 1.0000000E 00,  0.0000000E 00,  1.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
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        9.9998999E-01, ZP    =  9.9998999E-01,  9.9998999E-01,  9.9998999E-01, ZU    =  5.0000000E-01,
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        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
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        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
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        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
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        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
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        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
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        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
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        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,
        0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00,  0.0000000E 00, STAT  =  2.0000000E 01,
DTO   = 3.0000000E 01, DTI   =  3.0000000E 01, IFLAG =              0
&END
   DATE - JULY 30, 1976          UNIT - CLASS 2 LRU NO. 1        ANALYSIS - THREE LRU CLASSES
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                         COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                          USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                          MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                             ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.
UNIT - CLASS 1 LRU NO. 1                                                             ANALYSIS - THREE LRU CLASSES
   TOTAL                                                                                DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL
EACH      CUM
     189.      189.     THOUSANDS OF DOLLARS
PRIME     T.E.      TE SPACE MANPOWER  SUPPLY    ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
       0.        0.        0.        0.       82.        0.        0.      106.        1.      189.

PROVISION        INITAL BUY                             CONSUMED         RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART                 UNIT  MODULE PART UNIT  MODULE PART
   17.    4.    2.  198.  202.  204.                   0.    0.    2.   17.    4.    0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA
                DIRECT                                          GENERAL                                   DEPOT
     T.E.                              REPAIR     T.E.                              REPAIR     T.E.                              REPAIR
     EACH       CUM       EACH        CUM       EACH       CUM       EACH        CUM       EACH       CUM       EACH        CUM
   0.0000    0.0000    0.0000     0.0000    0.0000    0.0000    0.0000     0.0000     .0057     .0057     .0065      .0065
             0.0000               0.0000              0.0000               0.0000               .0057                 .0065

ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
          DIRECT                          GENERAL                           DEPOT
T.E.       TE MEN     REP MEN    T.E.      TE MEN     REP MEN    T.E.      TE MEN     REP MEN
   0.         0.         0.         0.        0.         0.         0.        0.         0.
0.0000                         0.0000                         0.0000
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
          DEPOT
T.E.       TE MEN     REP MEN
     0.         0.         0.
   0.0000

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
     189.      189.     MANPOWER        0.     DELTA          0.     PV DELTA       0.
INITIAL PROVISION QUANTITIES OF
                       UNITS                                            MODULES                                   PARTS
   EQPT.      DIRECT     GENERAL       DEPOT          DIRECT     GENERAL      DEPOT          DIRECT     GENERAL      DEPOT
     0.         13.         4.           0.             0.          0.          4.             0.          0.          2.
COST OF INITIAL PROVISION                                               RESIDUAL
         EQPT.        DIRECT        GENERAL       DEPOT        TOTAL
UNIT          0.          13.             4.          0.          17.          17.
MODULE                     0.             0.          6.           6.           6.
PART                       0.             0.          0.           0.           0.
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                                   COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                                    USING LIFE CYCLE COST OF OWNERSHIP AND OPERATICNAL AVAILABILITY AS THE
                                     MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                                       ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.
UNIT - CLASS 1 LRU NO. 2                                                          ANALYSIS - THREE LRU CLASSES
  TOTAL                                                                              DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL
EACH      CUM
    226.      415.     THOUSANDS OF DOLLARS
PRIME     T.E.      TE SPACE MANPOWER  SUPPLY     ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
     0.        0.        0.        0.       82.        0.        0.     144.        1.      226.

PROVISION          INITAL BUY                                    CONSUMED           RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART                            UNIT  MODULE PART UNIT  MODULE PART
  17.     4.    2.  198.  202.  204.                              0.     0.    1.   17.    4.    0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA
                 DIRECT                                           GENERAL                                     DEPOT
    T.E.                                 REPAIR     T.E.                                 REPAIR     T.E.                                REPAIR
    EACH       CUM        EACH        CUM       EACH        CUM        EACH        CUM       EACH        CUM        EACH        CUM
  0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000      .0055      .0112      .0063      .0129
             0.0000                0.0000                0.0000                0.0000                 .0112                 .0129

ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
           DIRECT                              GENERAL                                 DEPOT
T.E.       TE MEN     REP MEN    T.E.       TE MEN     REP MEN    T.E.       TE MEN     REP MEN
   0.         0.         0.         0.         0.         0.         0.         0.         0.
0.0000                        0.0000                         0.0000
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
            DEPOT
T.E.       TE MEN     REP MEN
     0.         0.         0.
  0.0000

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
    226.      415.     MANPOWER        0.      DELTA          0.     PV DELTA        0.
INITIAL PROVISION QUANTITIES OF
                         UNITS                                                       MODULES                                           PARTS
  EQPT.      DIRECT     GENERAL        DEPOT           DIRECT     GENERAL      DEPOT            DIRECT     GENERAL        DEPOT
    0.         13.          4.            0.               0.         0.          4.                 0.          0.            2.
COST OF INITIAL PROVISION                                                       RESICUAL
         EQPT.        DIRECT        GENERAL        DEPOT        TOTAL
UNIT        0.           13.            4.            0.          17.          17.
MODULE                    0.            0.            6.           6.           6.
PART                      0.            0.            0.           0.           0.
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                          COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTEC MICOM MISSILE LRUS
                           USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                           MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                             ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.
UNIT - CLASS 1 LRU NO. 3                                                                  ANALYSIS - THREE LRU CLASSES
   TOTAL                                                                                      DATE - JANUARY 2,1977


PRESENT VALUE COST TOTAL
EACH      CUM
      280.       696.    THOUSANDS OF DOLLARS
PRIME      T.E.        TE SPACE MANPOWER  SUPPLY     ORDERING  STORAGE    S.ADMIN   SHIPPING  TOTAL
      0.         0.         0.         0.        179.         2.          0.        99.         1.      280.


PROVISION          INITAL BUY                                        CONSUMED           RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART                                UNIT  MODULE PART UNIT  MODULE PART
   76.    26.    3.  257.  283.  286.                                  0.     0.   19.   76.   26.    0.


TEST EQUIPMENT AND REPAIR CHANNEL DATA
                 DIRECT                                          GENERAL                                  DEPOT
      T.E.                               REPAIR     T.E.                               REPAIR     T.E.                              REPAIR
      EACH       CUM        EACH          CUM       EACH        CUM        EACH         CUM       EACH        CUM        EACH         CUM
    0.0000     0.0000     0.0000       0.0000     0.0000      0.0000     0.0000       0.0000     .0100      .0213      .0136       .0264
               0.0000                  0.0000                 0.0000                  0.0000                .0213                  .0264


ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
               DIRECT                             GENERAL                               DEPOT
T.E.        TE MEN     REP MEN    T.E.       TE MEN     REP MEN    T.E.       TE MEN     REP MEN
    0.         0.         0.         0.         0.         0.         0.         0.         0.
0.0000                          0.0000                            0.0000
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
             DEPOT
T.E.        TE MEN     REP MEN
      0.         0.         0.
   0.0000


EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
      280.      696.   MANPOWER       0.    DELTA          0.    PV DELTA      0.
INITIAL PROVISION QUANTITIES OF
                        UNITS                                                 MODULES                                         PARTS
  EQPT.       DIRECT     GENERAL       DEPOT         DIRECT      GENERAL      DEPOT          DIRECT      GENERAL        DEPOT
    0.          35.        18.          23.            0.          0.          26.             0.           0.            3.
COST OF INITIAL PROVISION                                              RESIDUAL
           EQPT.       DIRECT       GENERAL       DEPOT        TOTAL
UNIT          0.          35.          18.          23.          75.          75.
MODULE                     0.           0.          26.          26.          26.
PAPT                       0.           0.           0.           0.           0.
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COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
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ANALYSIS - THREE LRU CLASSES
DATE - JANUARY 2,1977

UNIT - CLASS 1 LRU NO. 4
TOTAL

PRESENT VALUE COST TOTAL

EACH	CUM
161.	857.

THOUSANDS OF DOLLARS

PRIME	T.E.	TE SPACE	MANPOWER	SUPPLY	ORDERING	STORAGE	S.ADMIN	SHIPPING	TOTAL
0.	0.	0.	0.	137.	0.	0.	23.	1.	161.

PROVISION			INITAL BUY			CONSUMED			RESIDUAL		
UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART
76.	26.	29.	257.	283.	312.	0.	0.	486.	76.	26.	0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA

DIRECT				GENERAL				DEPOT			
T.E. EACH	CUM	EACH	REPAIR CUM	T.E. EACH	CUM	EACH	REPAIR CUM	T.E. EACH	CUM	EACH	REPAIR CUM
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.0075	.0288	.0090	.0355
	0.0000		0.0000		0.0000		0.0000		.0288		.0355

ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS

DIRECT			GENERAL			DEPOT		
T.E.	TE MEN	REP MEN	T.E.	TE MEN	REP MEN	T.E.	TE MEN	REP MEN
0.	0.	0.	0.	0.	0.	0.	0.	0.
0.0000			0.0000			0.0000		

ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS

DEPOT		
T.E.	TE MEN	REP MEN
0.	0.	0.
0.0000		

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL

EACH	CUM	MANPOWER	DELTA	PV DELTA
161.	857.	0.	0.	0.

INITIAL PROVISION QUANTITIES OF

	UNITS			MODULES			PARTS		
EQPT.	DIRECT	GENERAL	DEPOT	DIRECT	GENERAL	DEPOT	DIRECT	GENERAL	DEPOT
0.	35.	18.	23.	0.	0.	26.	0.	0.	29.

COST OF INITIAL PROVISION

	EQPT.	DIRECT	GENERAL	DEPOT	TOTAL	RESIDUAL
UNIT	0.	26.	13.	17.	56.	56.
MODULE		0.	0.	23.	23.	23.
PART		0.	0.	0.	0.	0.

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                              COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                               USING LIFE CYCLE COST OF OWNERSHIP AND OPERATICNAL AVAILABILITY AS THE
                                MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                                  ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.
UNIT - CLASS 2 LRU NO. 1                                                                 ANALYSIS - THREE LRU CLASSES
  TOTAL                                                                                    DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL
EACH     CUM
  13926.    14782.    THOUSANDS OF DOLLARS
PRIME     T.E.       TE SPACE MANPOWER  SUPPLY     ORDERING STORAGE   S.ADMIN   SHIPPING  TOTAL
     0.        0.          0.       0.    13591.        7.       0.       311.       16.   13926.

PROVISION        INITAL BUY                                   CONSUMED         RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART                         UNIT  MODULE PART UNIT  MODULE PART
  160.   13.    3.  341.  354.  357.                            0.     0.   34.  160.   13.    0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA
           DIRECT                                             GENERAL                                 DEPOT
    T.E.                              REPAIR      T.E.                            REPAIR      T.E.                           REPAIR
    EACH        CUM      EACH           CUM       EACH        CUM      EACH         CUM       EACH        CUM      EACH        CUM
   0.0000    0.0000    0.0000        0.0000      .0206      .0206     .0206       .0206      .0222      .0510     .0307      .0662
             0.0000                  0.0000                 .0206                 .0206                 .0510                .0662

ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
             DIRECT                     GENERAL                                DEPOT
T.E.       TE MEN     REP MEN   T.E.      TE MEN    REP MEN   T.E.      TE MEN    REP MEN
  0.         0.         0.        0.        0.        0.        0.        0.        0.
0.0000                         0.0000                        0.0000
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
             DEPOT
T.E.       TE MEN     REP MEN
    0.        0.         0.
  0.0000

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH     CUM
  13926.    14782.    MANPOWER       0.    DELTA         0.    PV CELTA       0.
INITIAL PROVISION QUANTITIES OF
                  UNITS                                          MODULES                                             PARTS
  EQPT.      DIRECT    GENERAL      DEPOT          DIRECT    GENERAL     DEPOT          DIRECT     GENERAL         DEPOT
    0.         123.       22.         15.              0.         6.        7.              C.          0.            3.
COST OF INITIAL PROVISION                                            RESIDUAL
        EQPT.       DIRECT       GENERAL       DEPOT        TOTAL
UNIT       0.        7101.         1270.        866.        9237.        9237.
MODULE                  0.          187.        218.         406.         406.
PART                    0.            0.          1.           1.           0.
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COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
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UNIT - CLASS 2 LRU NO. 2
TOTAL

ANALYSIS - THREE LRU CLASSES
DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL

EACH	CUM	
3861.	18643.	THOUSANDS OF DOLLARS

PRIME	T.E.	TE SPACE	MANPOWER	SUPPLY	ORDERING	STORAGE	S.ADMIN	SHIPPING	TOTAL
0.	0.	0.	0.	3610.	6.	0.	235.	11.	3861.

PROVISION			INITAL BUY			CONSUMED			RESIDUAL		
UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART
132.	15.	3.	313.	328.	331.	0.	0.	34.	132.	15.	0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA

DIRECT				GENERAL				DEPOT			
T.E.			REPAIR	T.E.			REPAIR	T.E.			REPAIR
EACH	CUM	EACH	CUM	EACH	CUM	EACH	CUM	EACH	CUM	EACH	CUM
0.0000	0.0000	0.0000	0.0000	.0154	.0360	.0131	.0337	.0178	.0688	.0238	.0900
	0.0000		0.0000		.0360		.0337		.0688		.0900

ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS

DIRECT			GENERAL			DEPOT		
T.E.	TE MEN	REP MEN	T.E.	TE MEN	REP MEN	T.E.	TE MEN	REP MEN
0.	0.	0.	0.	0.	0.	0.	0.	0.
0.0000			0.0000			0.0000		

ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS

DEPOT		
T.E.	TE MEN	REP MEN
0.	0.	0.
0.0000		

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL

EACH	CUM						
3861.	18643.	MANPOWER	0.	DELTA	0.	PV DELTA	0.

INITIAL PROVISION QUANTITIES OF

	UNITS			MODULES			PARTS		
EQPT.	DIRECT	GENERAL	DEPOT	DIRECT	GENERAL	DEPOT	DIRECT	GENERAL	DEPOT
0.	101.	18.	13.	0.	6.	9.	0.	0.	3.

COST OF INITIAL PROVISION

	EQPT.	DIRECT	GENERAL	DEPOT	TOTAL	RESIDUAL
UNIT	0.	1779.	317.	229.	2325.	2325.
MODULE		0.	68.	101.	169.	169.
PART		0.	0.	1.	1.	0.

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                 COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                  USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                   MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                     ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

  ANALYSIS - THREE LRU CLASSES                                                            DATE - JANUARY 2,1977
                                                        CASE TOTAL
  COST TOTALS, COST IN THOUSANDS OF DOLLARS                                          RECURRING COSTS
     INSTALLED EQUIPMENT                    0.
     TEST EQUIPMENT                      5752.                                 T.E. MAINTENANCE      386.
     TEST EQUIPMENT SPACE                   0.                             DEPOT SPACE/UTILITIES       0.
     MAINTENANCE MANPOWER                2012.           FIELD      1002.  DEPOT     898. TOTAL     1900.
                                                TRAINING FIELD        59.  DEPOT      53. TOTAL      112.
     SUPPLY MATERIAL                    78597.                                         SUPPLIES    17914.
     REORDERING                            76.                                       REORDERING       76.
     MATERIAL STORAGE                      11.                                 MATERIAL STORAGE       11.
     SUPPLY ADMINISTRATION               1479.                             INVENTORY MANAGEMENT     1186.
     SHIPPING AND HANDLING                272.                                         SHIPPING      272.

     GRAND TOTAL COST                   88199.                                  TOTAL RECURRING    21856.

     PRESENT VALUE                                                          COST OF INITIAL PROVISION
     DEVELOPMENT                         3619.                                            UNITS    57877.
     ACQUISITION                        62723.                                          MODULES     2799.
     OPERATION AND MAINTENANCE          21856.                                            PARTS        8.
     END LIFE SALVAGE                       0.                                  TOTAL PROVISION    60683.

     GRAND TOTAL                        88199.

  EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

     MAINTENANCE MANPOWER                2012.
     GRANC TOTAL COST                   88199.
     PRESENT VALUE
     OPERATION AND MAINTENANCE          21856.
     GRAND TOTAL                        88199.        CELTA        0.           PV DELTA        0.
 CAYZ=  .997990   .999763   .998679  .999546
CAYZI=  .997990   .999763   .998679  .999546
                         MAN-E          DIRECT        GENERAL        DEPOT
HOURS PER DAY
   TEST EQUIPMENT        6.808          0.000          4.454         5.734
   REPAIR                0.000          0.000          6.714        10.249
NUMBER OF MEN
   TEST EQUIPMENT        0.000          0.000          1.559         2.007
   REPAIR                1.000          0.000          2.350         3.587
SENSITIVITY PASS    2   LRU   12   VAR( 76)=  .3000000E-03   VAR(
SENSITIVITY PASS    2   LRU   13   VAR( 76)=  .3000000E-03   VAR(
SENSITIVITY PASS    2   LRU   14   VAR( 76)=  .1500000E-02   VAR(
SENSITIVITY PASS    2   LRU   15   VAR( 76)=  .1500000E-02   VAR(
SENSITIVITY PASS    2   LRU   16   VAR( 76)=  .6300000E-02   VAR(
SENSITIVITY PASS    2   LRU   17   VAR( 76)=  .5100000E-02   VAR(
SENSITIVITY PASS    2   LRU   18   VAR( 76)=  .3300000E-02   VAR(
SENSITIVITY PASS    2   LRU   19   VAR( 76)=  .3000000E-02   VAR(
SENSITIVITY PASS    2   LRU   20   VAR( 76)=  .2400000E-02   VAR(
SENSITIVITY PASS    2   LRU   21   VAR( 76)=  .3000000E-02   VAR(
SENSITIVITY PASS    2   LRU   22   VAR( 76)=  .3900000E-02   VAR(
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                          COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                           USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                            MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                              ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 3 LRU NO. 2                                                          ANALYSIS - THREE LRU CLASSES
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS                     DATE - JANUARY 2,1977

PRESENT VALUE COST TOTAL
EACH      CUM
   11740.   27780.    THOUSANDS OF DOLLARS                 AVAILABILITY=  .999744  INHERENT=  .999744
PRIME    T.E.       TE SPACE MANPOWER  SUPPLY    ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
      0.     906.        0.     536.    10122.         3.       7.        73.        94.   11740.

PROVISION          INITIAL BUY          REORDER BUY           CONSUMED           RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART
  105.    1.    1.  145.  146.  147.   20.    50.  100.    0.     0.   18.  105.    1.    0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA
               DIRECT                                               GENERAL                                      DEPOT
      T.E.                         REPAIR      T.E.                              REPAIR     T.E.                               REPAIR
      EACH       CUM       EACH      CUM       EACH       CUM        EACH          CUM      EACH         CUM         EACH         CUM
    0.0000    0.0000     0.0000   0.0000     0.0000    0.0000      0.0000       0.0000     .0204       .0757        .0697       .1598
              0.0000              0.0000                .0172                    .0209                 .0757                    .1598

ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
          DIRECT                        GENERAL                                     DEPOT
T.E.      TE MEN     REP MEN   T.E.       TE MEN     REP MEN   T.E.        TE MEN     REP MEN
    0.        0.         0.        0.         0.         0.        0.          0.         0.
0.0000                          0.0000                          0.0000
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
           DEPOT
T.E.      TE MEN     REP MEN
     1.        0.          1.
   .0833

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
   11740.   27780.     MANPOWER      536.      DELTA          0.     PV DELTA       0.
INITIAL PROVISION QUANTITIES OF
                       UNITS                                                 MODULES                                         PARTS
   EQPT.      DIRECT     GENERAL       DEPOT          DIRECT     GENERAL        DEPOT          DIRECT      GENERAL        DEPOT
     0.          44.         24.         37.              0.          0.           1.              0.           0.           1.
COST OF INITIAL PROVISION                                                 RESIDUAL
           EQPT.      DIRECT      GENERAL      DEPOT        TOTAL
UNIT          0.       3312.        1806.      2785.        7903.      7903.
MODULE                    0.           0.        33.          33.        33.
PART                      0.           0.         0.           0.         0.
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              COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
              USING LIFE CYCLE COST OF OWNERSHIP AND OPERATICNAL AVAILABILITY AS THE
               MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                 ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

ANALYSIS - THREE LRU CLASSES                                                          DATE - JANUARY 2,1977
                                                   CASE TOTAL
COST TOTALS, COST IN THOUSANDS OF DOLLARS                                        RECURRING CCSTS
     INSTALLED EQUIPMENT              0.
     TEST EQUIPMENT                1681.                                   T.E. MAINTENANCE       391.
     TEST EQUIPMENT SPACE             0.                              DEPOT SPACE/UTILITIES         0.
     MAINTENANCE MANPOWER           761.         FIELD      213.  DEPOT        516. TOTAL       729.
                                         TRAINING FIELD      13.  DEPOT         19. TOTAL        32.
     SUPPLY MATERIAL              24587.                                           SUPPLIES     5471.
     REORDERING                      21.                                         REORDERING       21.
     MATERIAL STORAGE                 7.                                   MATERIAL STORAGE        7.
     SUPPLY ADMINISTRATION          585.                              INVENTORY MANAGEMENT       462.
     SHIPPING AND HANDLING          137.                                           SHIPPING      137.

     GRAND TOTAL COST             27780.                                    TOTAL RECURRING     7251.


     PRESENT VALUE                                                      COST OF INITIAL PROVISION
     DEVELOPMENT                      0.                                              UNITS    18368.
     ACQUISITION                  20529.                                            MODULES      746.
     OPERATION AND MAINTENANCE     7251.                                              PARTS        2.
     END LIFE SALVAGE                 0.                                    TOTAL PROVISION    19117.

     GRAND TOTAL                  27780.

EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL

     MAINTENANCE MANPOWER           761.
     GRAND TOTAL COST             27780.
     PRESENT VALUE
     OPERATION AND MAINTENANCE     7251.
     GRAND TOTAL                  27780.          DELTA         0.          PV DELTA        0.
 CAYZ=  .997988  .999762  .998679  .999546
CAYZI=  .997990  .999763  .998679  .999546
                 MAN-E          DIRECT         GENERAL          DEPOT
HOURS PER DAY
  TEST EQUIPMENT        1.931          0.000           1.815          1.999
  REPAIR                0.000          0.000           2.009          3.835
NUMBER OF MEN
  TEST EQUIPMENT        0.000          0.000            .635           .708
  REPAIR                1.000          0.000            .703          1.342
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        COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
         USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
          MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
            ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

                                                                                     DATE - JANUARY 2,1977
ANALYSIS - THREE LRU CLASSES
                                               GRAND TOTAL
COST TOTALS, COST IN THOUSANDS OF DOLLARS                                         RECURRING COSTS
    INSTALLED EQUIPMENT                0.
    TEST EQUIPMENT                  7433.                                    T.E. MAINTENANCE        777.
    TEST EQUIPMENT SPACE               0.                                DEPOT SPACE/UTILITIES         0.
    MAINTENANCE MANPOWER            2773.              FIELD     1215.  DEPOT     1415. TOTAL       2629.
                                               TRAINING FIELD      72.  DEPOT       72. TOTAL        143.
    SUPPLY MATERIAL               103185.                                             SUPPLIES     23385.
    REORDERING                        98.                                           REORDERING        98.
    MATERIAL STORAGE                  18.                                     MATERIAL STORAGE        18.
    SUPPLY ADMINISTRATION           2964.                                 INVENTORY MANAGEMENT      1648.
    SHIPPING AND HANDLING            409.                                             SHIPPING       409.

    GRAND TOTAL COST              115979.                                      TOTAL RECURRING     29107.

    PRESENT VALUE                                                         COST OF INITIAL PROVISION
    DEVELOFMENT                     3619.                                                UNITS     76245.
    ACQUISITION                    83252.                                              MODULES      3545.
    OPERATION AND MAINTENANCE      29107.                                                PARTS        10.
    END LIFE SALVAGE                   0.                                      TOTAL PROVISION     79800.

    GRAND TOTAL                   115979.

EXPECTED VALUE MANPOWER AT CIRECT AND GENERAL

    MAINTENANCE MANPOWER            2773.
    GRANC TOTAL COST              115979.
    PRESENT VALUE
    OPERATION AND MAINTENANCE      29107.
    GRAND TOTAL                   115979.      CELTA        0.        PV DELTA        0.

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